g18

Version 2.0

GPRS / GSM Engine / Modem Integration and Application Developers Guide

Motorola offers this information to our customer as a service to assist in the applications and engineering efforts with our products. Motorola is basing this information only on what has been provided specifically to Motorola by our customer. Motorola has not undertaken any independent search for additional relevant information, including any information that may be in our customer's possession. Furthermore, system validation of this Motorola product within a larger electronic system remains the responsibility of our customer or our customer's system integrator.

Manual number 98-89293L01

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I Revision History

Revision	Date	Purpose
1.0	7 April 01	G18 developer guide first version
2.0	15 Oct 01	Update VII Customer Assistance
		Update table2 "g18 compatibility with d15" Ch. 2
		Turn On/Off timings" Ch. 3.1.2
		Update "How / When to make the unit to wakeup" Ch. 3.1.3
		Update audio levels Ch. 3.1.6
		Update "Port Configuration" at Ch. 3.1.8
		Update DTR & DCD lines - Ch 3.1.9
		New Chapter "Setting Baud rate" - Ch. 3.1.10
		Update "Sending Fax" Ch. 4.1.17
		New Chapter "How to establish GPRS context" Ch 4.1.18
		New Chapter" How to change Pin code number" Ch 4.1.19
		New Chapter " How to write into the fix dialling (FD) phone book" Ch. 4.1.20
		Update table 13 in " Basic AT Command list"
		Update table 16 in "Advance AT command list"
		Update table 23 in "ETSI 07.07 mobile equipment Control and status commands"
		Update table 25 in "V.25ter commands used with GSM"
		Update table 29 in "ETSI 07.05 text mode"
		Update table 30 in "ETSI 07.05 PDU mode"
		Update Spec. Annex B
		Update Annex C. Ch. 1.1, 1.2, 1.3, 1.4, 1.8, 2.1, 2.5, 2.6, 2.7, 2.13, 2.14, 2.15, 2.16, 2.17, 2.22, 2.27, 2.37, 2.46, 2.54, 2.57, 2.58, 2.59, 2.70, 2.71, 2.72
		Add in Annex E "Default Dip switch/Jumpers setting"
		New Annex G "IPs over AT commands list"

II Using This Guide

This guide presents critical research and development (R and D) issues affecting the design and development of products incorporating the Motorola g18 900/1800/1900MHz GSM/GPRS Integrated Wireless Modem, used in North America, Asia, and Europe.

The purpose of this document is to describe the technical details needed to integrate g18 Tri-band 900, 1800 and 1900 MHz Data Module into a host device. The g18 Data Module is the next generation that replaces the current d15 Data Module. There are several configurations of this product that are described with in this document that provides flexibility in full system integration needs

NOTE: A product that incorporates the modem is referred to as the Original Equipment Manufacturer (OEM) host or simply the host.

III Purpose

Data terminal equipment (DTE) OEM teams are often pulled together quickly from other work groups. For this reason, OEM team members often need advice about how to best sustain a concerted design and development effort. The goal of this guide is to assist your team to successfully produce a wireless product that integrates a Motorola g18 wireless modem.

This guide strives to bridge the gap between the various engineering and business disciplines that make up OEM teams. Our approach is to provide a practical disclosure of useful information that can offer a common understanding of the problems you may encounter and examples of probable solutions.

We at Motorola want to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements. You can reach us initially by Email : GSM support-BSH015@email.mot.com

IV Intended Audience

Our readers are intended to be data terminal equipment (DTE) OEM integration team members. Teams historically consist of representative from the disciplines of hardware, software, and RF engineering. These readers will probably find the entire document useful, if not enlightening. Other readers include marketing, business, and program managers. These readers might find the first chapter, which discusses the integrator's task, to be sufficiently informative for their needs. The remaining chapters go into more detail.

V Disclaimer

This guide provides advice and guidelines to OEM teams. Responsibility for how the information is used lies entirely with the OEM. Statements indicating support provided by or offered by Motorola are subject to change at any time.

Motorola reserves the right to make any changes to this specification

VI Reference Documents

- *Electromagnetic Compatibility*: Principles and Applications by David A Weston, published by Marcel Dekker, Inc., 270 Madison Avenue, New York, NY 10016 USA.
- *GSM 07.07 - prETS 300 916*, Digital cellular telecommunication system (Phase 2+); AT command set for GSM Mobile Equipment (ME), Version 5.2.0 or higher, Reference RE/SMG-040707QR1
- *GSM 07.05*, Digital cellular telecommunication system (Phase 2+); Use of Data Terminal Equipment - Data Circuit terminating; Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS), Version 5.3.0, August, 1997, Reference TS/SMG-040705QR2
- *GSM 03.40*, Digital cellular telecommunication system (Phase 2+); Technical realization of the Short Message Service (SMS) Point-to-Point (PP), Version 5.3.0, July 1996, Reference TS/SMG-040340QR2
- *GSM 04.11* Digital cellular telecommunication system (Phase 2+); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface, Version 5.1.0, March 1996, Reference TS/SMG-030411QR
- *GSM 03.38*, Digital cellular telecommunication system (Phase 2+); Alphabets and language-specific information, Version 5.3.0, July 1996, Reference TS/SMG-040338QR2
- *GSM 11.10-1*, Digital cellular telecommunication system (Phase 2); Mobile Station (MS) Conformance specification; Part 1: Conformance specification. Draft pr ETS 300 607-1, March 1998, Reference RE/SMG-071110PR6-1
- GSM Specifications are orderable from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112-5704 USA 303-792-2181 800-624-3974
- ETSI Standard PCS - *11.10-1*
- *GSM 02.30* Supplementary services.
- *GSM 03.90* USSD stage 2.
- *GSM 11.14* SIM toolkit.
- ITU-T *V.25ter*
- GSM Data Adapter for Motorola Handsets, AT command reference, Rev 2, June 9 1997.
- ETSI standard SMG31.
- GSM 05.02.
- ETSI 07.60.
- ETSI 0.7.07 Ver. 7.5.0.

VII Customer Assistance

This page is placed as a source of contact information for any possible queries that may arise.

Have questions
Trouble getting the evaluation board set up
Technical questions
Configuration questions/problems
Technical operating problems
Need documentation

GSM data module Customer Support Center is ready to assist you on integration issues
Help desk phone number is: **+972-3-5684040**
Email : BSH015@email.mot.com

At Motorola, Total Customer Satisfaction is a top priority. If you have a question, a suggestion or a concern about your Motorola g18 product. Motorola wants to hear from you.

Please contact the Motorola Cellular Response Center by Fax on +44 (0) 131 458 6732 or use one of the local phone numbers in the following countries for general product inquiries.

Austria	0800297246	Norway	22 55 10 04
Belgium	0800 72 370	Portugal	21 318 0051
Denmark	4348 8005	Sweden	08 445 1210
Eire	01 402 6887	Switzerland	0800 553 109
Finland	0800 117036	UK	0500 55 55 55
France	0 803 303 302	Honk Kong	852 25063888
Italy	02 696 333 16	People's Republic of China	86 10 68466060
Luxembourg	0800 21 99	Singapore	65 4855 333
Netherlands	0800 022 27 43	United States of America	1 800 331 6456
Canada	1 800 461 4575		

Accessory items available to aid the developer.

S9002B Developer Kit
Kit contains:

Hardware	01-85702G03	Antenna	85-09397T03
Antenna adapter cable	30-85720G01	Handset	SCN5011A
Flex cable, 36 line ZIF	30-85717G04	HUC	SYN9048A
Flex cable, 30 line ZIF	30-85717G01	BD, evaluation	FTN8071B
Chip SIM card, phase 2	81-02430Z04		

Notes:
1. The part number 8102430Z04 refer to Test SIM card. The supplier is Gemplus International GmbH.
2. On the SIM card supplied with the developer's kit, if when using them the pin number is requested, it will be "0000"
3. Manual for the handset with details of the menu structure is available from the Customer Support Center.

Accessory individual items

SCN5012A	Handset without SIM
SYN6962A	Headset
SYN4937A	Headset
SSN4018A	Speaker
SMN4097A	MIC
HFK9200A	DHFA Digi
39-03920K01	Antenna contact on EV board
8287427L01	GPRS Wizard
FTN8105A	D15 EV board Retrofit kit for g18 support - Contact salesman for details.

If you wish to place an order, please contact your Account Manager. A list of Motorola Account Managers is available at www.mot.com/ies/telematics/. Click onto "Products", then "Data Modules" then "Contact Us".

VIII Regulatory Requirements

Investigate and Obtain Regulatory Approval

Most countries where the final product will be sold currently require approval from the local government regulatory body. It is your responsibility to investigate and obtain the proper regulatory approval and certification for each country in which the product is sold. Motorola can provide the contact names and phone numbers of the regulatory bodies in each country.

You are required to obtain regulatory approval of products that integrate a g18 integrated wireless modem. The specific details for achieving regulatory approval vary from country to country.
Worldwide, government regulatory agencies for communications have established standards and requirements for products that incorporate fixed, mobile, and portable radio transmitters. To this end, Motorola provides g18 modems as certified in specific regional markets to levels of compliance appropriate for an integrated device. Approvals are required for two interrelated reasons: to guard public safety and to ensure electrical non-interference
UL, CSA, and other safety approvals are not required, except that AUSTEL safety approval in Australia is required of network operators. This means, in Australia the network operators might pass AUSTEL safety requirements through to the device integrators.

IX Full-Product Certification

As the integrator, you must determine what additional specific regulatory requirements are required of the country in which your product is marketed. This means that your product must be individually certified, even though the g18 modems are already approved. The certification process includes submittal of prototype products and acceptable test results.

Be prepared for the certification process for your product to take from a few weeks to several months. Its duration can be affected by safety requirements, the type of product, and the country in which you are seeking approval.

X Country Requirements

These country requirements are provided as a general orientation to the certification processes in specific regions and countries. You are strongly encouraged to use the services of a consultant or a full-service test house if you have limited expertise in meeting the regulatory requirements of a specific country.

XI Countries of the European Union and EFTA

Since April 8th 2000 radio and telecommunication equipment are regulated under directive 1999/5/EC of the European Union. This directive is referred to as the RTTED.
For equipment within its scope the RTTED supersedes the Telecommunication Terminal Equipment directive (TTE 98/13/EC), the Electromagnetic Compatibility Directive (EMC 89/336/EC) and the Low Voltage Directive (LVD 73/23/EC).

The RTTED and important information about it is published by the European Commission under wed address:

http://www.europa.eu.int/comm/enterprise/rtte/infor.htm

The requirements of the RTTED are given in article 3:
- Health and Safety in Article 3.1(a),
- EMC in Article 3.1 (b),
- Radio in Article 3.2,
- Optional requirements in article 3.3.

The harmonised standards used for the g18 to demonstrate compliance with the R&TTE directive are:
- EN60950 for Health and Safety,
- ETS 300 342 –1 for EMC in Article 3.1 (b),
- CTR 19 and 31as relevant parts of TBR 19 and TBR 31 for Radio.
- No optional requirements are applicable to GSM terminal equipment.

The implication of the RTTED is that integrators of the g18 will need to raise their own Declaration of Conformity under the RTTED using Annex III, IV or V.

Motorola recommends integrators of the g18 to document their compliance activities in a technical construction file under the following circumstances the Motorola test report for the g18 can be used to demonstrate compliance with article 3.2 of the RTTED:
- The g18 must be operated at the voltages described in the technical documentation.
- The g18 must not be mechanically or electrically changed.
- Usage of connectors should follow the guidance of the technical documentation.

A Declaration of Conformity and test reports for the g18 will be available upon request from Motorola. Requests should be made to your contact person within Motorola

Care should be taken as a product might fall under the scope of other directives or standards depending on the type of product.

The g18 is not approved under the automotive directive (95/54/EC), as it cannot be connected directly to the power supply or other systems of a vehicle without having additional electronic interfacing.

XII North American GSM type certification

The g18 complies with the requirements of PCS 1900 Type Certification scheme as setup by the PCS 1900 Type Certification Review Board (PTCRB) and is listed as PCS 1900 Type Certified product. This certification will be invalidated if the following conditions are not met:
- The g18 must be operated at the voltages described in the technical documentation.
- The g18 must not be mechanically or electrically changed.
- Usage of connectors should follow the guidance of the technical documentation.
- Handsets or external card readers must be certified.

XIII United States of America

The Federal Communications Commission (FCC) requires application for certification of digital devices in accordance with CFR Title 47, Part 2 and Part 15. This includes Electromagnetic Energy Exposure (EME) testing. As the g18 modem is not a stand alone transceiver but is an integrated module, the g18 cannot be tested by itself for EME certification. It is, however, your responsibility to have your completed device tested for EME certification

XIV Canada

This class B device also complies with all requirements of the Canadian Interference-Causing Equipment Regulations (ICES-003).

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

X V Regulatory Statement

The following regulatory statement for the E.E.A applies to the g18 type MG1-4F21 only:

1. The g18 must be operated at the voltages described in the technical documentation.
2. The g18 must not be mechanically nor electrically changed. Usage of connectors should follow the guidance of the technical documentation.
   The g18 is type approved under CTR 5 ed.2 and CTR 9 ed.2. Using different external card readers or handsets other than those approved by Motorola will invalidate the type approval and require retesting and re-approval by the British Approval Board – Telecommunications (BABT). Such testing can only be carried out with prior approval of Motorola. It must be noted that CTR 5 ed.2 and CTR 9 ed.2 are expected to be repealed by October 24th. 1998, but changes approved prior to that date can be marketed after October 24.
3. The g18 has been designed the meet the EMC requirements of ETS 300 342.
4. When integrating the g18 into a system, Motorola recommends testing the system to ETS300342-1.
5. The g18 meets the safety requirements of EN60950.
6. Systems using the g18 will be subject to mandatory EMC testing under directive 89/336/EEC and only optional (see 3.) GSM type approval testing under directive 98/13/EEC. Other directives like the LVD directive 73/23/EEC might also be applicable to a system using g18.
7. The g18 is type approved at BABT. Changes subject to type approval should be communicated to Motorola and BABT, and are not subject for discussion with other Notified Bodies.

The above statement has been made on the basis of Motorola long experience in GSM type approvals for the E.E.A. and reviews with BABT of the UK. Motorola recommends that integrators of the g18 consult Motorola in the design phase to clarify any regulatory questions.

XVI g18 type certification identifications

Europe	MT3-411A21
US	FCC ID IHDT6AC1
Canada	CANADA 109331257A TYPE ACPA or CAN 109331257A TYPE
PTCRB	g18

XVI Safety

User Operation
Do not operate your telephone when a person is within 8 inches (20 centimeters) of the antenna. A person or object within 8 inches (20 centimeters) of the antenna could impair call quality and may cause the phone to operate at a higher power level than necessary and expose that person to RF energy in excess of that established by the FCC RF Exposure Guidelines.

IMPORTANT: The telephone must be installed in a manner that provides a minimum separation distance of 20 cm or more between the antenna and persons to satisfy FCC RF exposure requirements for mobile transmitting devices.

IMPORTANT: To comply with the FCC RF exposure limits and satisfy the categorical exclusion requirements for mobile transmitters, the following requirements must be met

Antenna Installation

1. A minimum separation distance of 20 cm must be maintained between the antenna and all persons.
2. The transmitter effective radiated power must be less than 3.0 Watts ERP (4.9 Watts or 36.9 dBm EIRP). This requires that the combination of antenna gain and feed line loss does not exceed 16 dBi.

CHAPTER 1 The Integrator's Task

This section provides background information and points out the objectives and tasks of reaching the goal of a successful implementation.

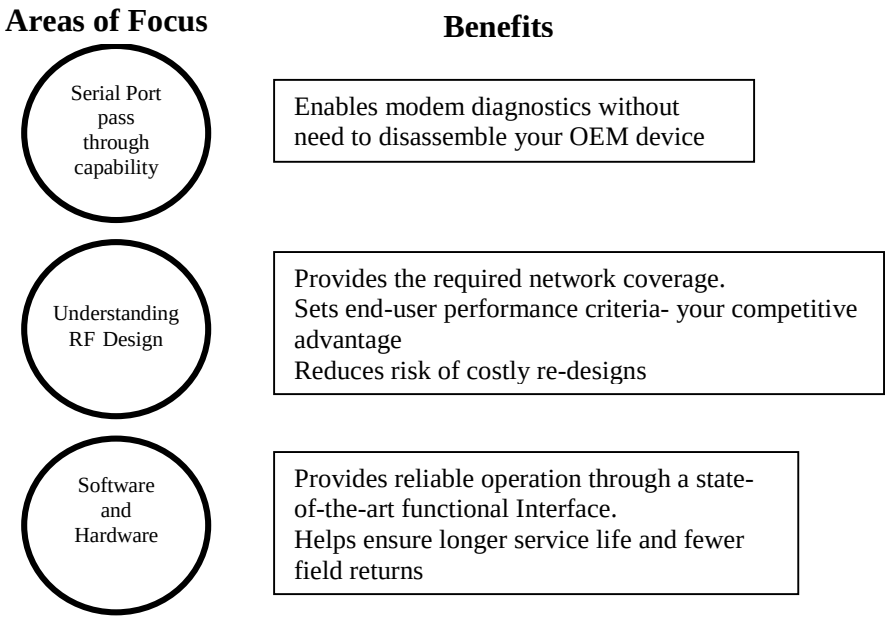

Areas of Focus
Benefits
Serial Port pass through capability
Enables modem diagnostics without need to disassemble your OEM device
Understanding RF Design
Provides the required network coverage.
Sets end-user performance criteria- your competitive advantage
Reduces risk of costly re-designs
Software and Hardware
Provides reliable operation through a state-of-the-art functional Interface.
Helps ensure longer service life and fewer field returns

Figure 1 - Integrator's Tasks

Introduction

As an OEM integrator, you must accurately choose where and how a wireless technology will facilitate communication for your customers. You will also have to evaluate which technical considerations will give your product an edge over the competition.

To successfully integrate g18 wireless modems into their host platforms, you must perform the following tasks:

- Plan the product and create the design
- Develop and validate the hardware
- Develop supporting applications software
- Test and approve the product

As you review these tasks, allow sufficient time for such required activities as the regulatory approval process, (see Regulatory Requirements) to identify critical path activities up front.

Plan the Product and create the Design

To plan the product and create the design, perform the following steps:

- Develop a usage model.
- Develop a message model.
- Define a service strategy.
- Investigate and obtain regulatory approval.

1.1.1 Develop a Usage Model

The usage model answers the question, “How will the end product be used (portable or mobile; eight hours, seven days a week; and so on)?”

Perhaps the most important enabler of success is a clear determination of how the final product is to be used. This steers the development process, because all design considerations drive toward meeting the needs of the final user. For example, design issues related to a mobile device, such as alternator noise and vibration, are completely different from considerations required for a fixed-point telemetry application powered by a solar panel. Defining what is and what is not important to the end user helps to make the critical engineering trade-off decisions that are inevitable in every product design.

It is your responsibility to develop the usage model. Motorola is available to provide assistance and answer questions, but is not directly involved in this phase of the project.

1.1.2 Develop a Message Model

The message model defines how many messages are sent/received and how often. To create the message model, determine how much and how often data will be sent in each of the up link (terminal to network) and down link (network to terminal) directions.

Answer the question, “Is there a requirement for the terminal to be on and able to receive eight hours a day, or does the user turn the unit on only when making a query to the host system?” The answer has a direct bearing on the battery size and capacity requirement for powering the device. The amount of data sent and received is relevant in calculating the cost of airtime and deciding on which type of network connection to use. In short, the message model is required source data for making many engineering design decisions, especially in calculating such values as sleep time versus wake time and in determining battery capacity requirements.

You are responsible for developing the message model. (For more information, see “Message Traffic Model” on page27.) The typical approach to creating the model is to define the peak and average network throughput requirements based on input from the user. Motorola is available to provide current consumption figures for each of the various modes of operation (receive and transmit, for example).

The network throughput of the host device depends on many factors in addition to the raw throughput of the radio channel. For example, in addition to the overhead involved in forward error correction and support for packet headers, the number of active users on the network can directly affect network throughput.

1.1.3 Define a Service Strategy

The service strategy determines whether the integrated modem is the cause of a user's problem and sets a policy for keeping the end user operational during repair. The service strategy must consider all potential service situations and evaluate them in light of the usage model. You can create the service strategy jointly with Motorola. Contact your Motorola OEM sales representative for details.

To ensure that a final product can be efficiently serviced, it is recommended you design for serviceability early in the R and D process. At a minimum, you could develop a functional service strategy that contains a well-considered procedure for performing unit-level screening. The test may primarily determine whether a fault lies with the modem or with the product. The test must also screen for network problems and human error.

Motorola has an evaluation board (a standalone test fixture). The evaluation board provides a mounting platform and electrical interface to the modem. Testing is performed much more efficiently while the modem is being integrated within the OEM host, whether for a factory end-of-line test or while at the user's site. (See Annex E)

For your product to allow integrated testing of the modem, you may decide to provide a modem pass-through mode.

A thoroughly developed OEM serviceability plan typically includes a needs assessment for developing software utilities that can assist in identifying communication problems between the product and the modem and between the modem and the RF network.

These utilities must be able to send commands to the modem, evaluate the modem responses, perform network connectivity testing, and verify data communication with the network.
Such a software utility is essential for field service engineers and shop technicians to diagnose problems with the product and to troubleshoot a problem to a failed assembly or mismanaged communication link.

1.1.4 Customer Problem Isolation

When customer problems are reported from the field, you must isolate the source of the problem remotely. You will need to determine what piece of the over all system is not functioning correctly. The following need to be considered as source of the problem:

1. Network
2. g18 wireless modem
3. Host product

Often it is a user's misunderstanding of how to use the product. Regardless, remote troubleshooting is essential to reducing the number of returned products and lowering service costs, particularly if the host must be disassembled for removal of the modem.
Motorola recommends that your product application (both at the terminal and host ends) incorporate sufficient problem diagnostic software to determine the cause of the problem remotely. Often, the best approach is to incorporate progressively deeper loop back tests to determine the point at which the communication link fails.
As stated elsewhere, you need to make this remote diagnostic functionality be part of your standard software load.

Develop and Validate the Hardware

To develop and validate the hardware, perform the following steps:

- Design the hardware platform
- Consider power supply options
- Select the source antenna
- Set up a development test environment

1.1.5 Design the Hardware Platform

Integrating a wireless modem into a hardware design requires many steps. Here again, the usage and message models are necessary to calculate issues such as battery size, heat dissipation, isolation from EMI, and physical mounting of the unit to ensure proper grounding. See “Design Considerations” Chapter 3

Hardware design is your responsibility. Motorola can provide recommendations where applicable. Motorola also provides a one-time verification of EMI-caused desense with the modem integrated into the host. To clarify, the host device can introduce electromagnetic interference, which will interfere with the performance of the modem. This EMI can be conducted into the modem via the serial and power lines, or radiated into the antenna and antenna cable. It is your task to minimize the generation of EMI by your device so that the modem’s RF performance is minimally affected. Contact your Motorola OEM representative for details.

1.1.6 Consider Power Supply Options

Power supply requirements vary according to the usage and message models. Beyond accounting for the current drain of the modem in its various operating modes, consider ripple and noise on the power lines and the ability to supply sufficient instantaneous current to allow proper operation of the transmitter. Also, ensure that your power supply can accommodate the highest power consumption for the g18 modem that you want to integrate.

Together, these requirements define the type and size of power supply (for example, linear versus switched) to use with the wireless modem. These issues are discussed in more detail see “design considerations” Chapter 3

1.1.7 Select the Source Antenna

The ERP generated by the antenna peak must meet the requirements of the various network operators: 3.16 watts ERP. Consider these network requirements when you select an antenna system. See “Antennas” in Chapter 3.
You are responsible for selecting a suitable antenna and submitting the final product to the network operator for certification. Motorola is available for consultation and to provide contact information for suitable antenna vendors.

1.1.8 Set Up a Development Test Environment

A number of development test aids are available to assist in hardware and applications development. Motorola makes the modem hardware and an evaluation board available for purchase; the evaluation board is a specially developed circuit board with test points and jumper switches. The evaluation board allows for maximum flexibility in accessing and controlling connections into and out of the modem. Motorola also provides various software utilities that can help in performing development tests. See “Testing” in chapter 6

Supplementing the test environment supported by Motorola, the network operator sometimes provides a live development network, one separate from the production network on which you can develop and test your application. You must negotiate directly with the network operator for airtime and for building and maintaining a development test environment at their facility.

Develop Supporting Applications Software

To develop supporting applications software, perform the following steps:

- Select a communications model
- Develop end-to-end applications software

Test and Approve the Product

To test and approve the product, perform the following steps:

- Perform EMI and desense testing (refer to Annex G p.170)
- Set up a final test environment
- Install and field test the product

1.1.9 Set Up a Final Test Environment

To ensure proper assembly of the final product (antenna properly connected, serial port operational, and so on), perform an end-to-end test that proves the final product can receive and transmit at the required signal levels. In locations where the final assembly test is performed within network coverage area, this test is relatively simple. But in locations where network coverage is not available, or for products to be shipped to another country, it is necessary to test by secondary means.

The final assembly test must verify that all connections to the modem are made correctly. Testing on a network is not required.

1.1.10 Install and Field Test the Product

When the product is shipped to a site, it is installed or mounted in a particular location, one that might restrict RF communications. The service question is whether the behaviour of a dysfunctional product is caused by poor coverage or a network service provider is down. To guarantee that the modem is located in an area of good coverage and that an end-to-end loop back message is possible, your product needs a software application to perform the test.

Your most effective approach to field-testing is to include an installation test procedure as part of your standard software load. Motorola can recommend specific network information that you can obtain from the modem describing how to implement an end-to-end loop back test. See “Testing” chapter 6.

Resource Assistance

Developing and testing a wireless integrated product requires a well-equipped development lab and access to resources and outside information. Table1, "Parts and Tools Requirements," below identifies required development and service tools. Additional topics note where the tools are available and how to get further assistance.

1.1.11 Integration Engineering Support

Questions on this manual and the integration process can be handled by the integration engineering teams located in Europe and North America.
Send email to:
BSH015@email.mot.com , with your name, phone number, company name, description of the project and your question and an engineer will be assigned to your project. The engineer will then contact you by phone or by email to assist you in resolving your issue.

Table 1 - Parts and Tools Requirements

	Related Documentation	
GSM Specifications	Refer to the Reference Documents Section	www.etsi.org
	Unique Development and Service Aids	
Host Evaluation Board kit	P/N S9002 This board provides interface connectors and circuitry to allow the modem to be powered and interfaced to a host device (PC) via a serial port and cable. Includes instructions, interface ribbon cable, jumpers Mounting hardware, antenna and Antenna cable. For evaluation board problems contact **+972-3-5684040**	
	Modem Test Equipment	
GSM Test Set	Rohde and Schwarz CMU 200 with GPRS option Hewlett Packard 8960 with GPRS option	www.rsd.de
GPS Test Set	Welnavigate GS700 or GS1010	www.hp.com
	Wireless Verification Equipment	
Live Network	Where available a Live network can be used	Network operator
	Traditional Shop Equipment	
Power Supply	Dual Power Supply with 3-6V/2A and 12V/2A output supplies (12V for optional Hands-free only – g18 EV board)	Commercial Items
Oscilloscope	900Mhz, digital Storage	Commercial Item
Digital Volt meter	Fluke 77 Multimeter or equivalent	Commercial Item

Environmental Issues

g18 Integrated Wireless Modems are designed for a combination of easy serviceability and general raggedness. These integrated modems are designed to be housed in an OEM host product. The modem is tested to conform to the environmental levels (for example, industrial use specifications and PC card standards) that meet the intended applications of most integrators. If you need additional raggedness and safety in your products, you must engineer the environmental characteristics of your host product to achieve a special safety rating.

1.1.12 General Precautions

Follow these precautions when you work with wireless modems.

- Minimize handling of static sensitive modules and components.
- Wear a grounded anti-static wrist strap while handling static-sensitive components.
- Do not bend or stress the modem in any way.
- Reinsert connectors straight and evenly to avoid causing short and open circuits.

1.1.13 ESD Handling Precautions

Any electronics device contains components sensitive to ESD (electrostatic discharge). For example, people experience up to 35 kV ESD, typically while walking on a carpet in low humidity environments. In the same manner, many electronic components can be damaged by less than 1000 volts of ESD. For this reason, you must observe the following handling precautions when servicing this equipment:

- Always wear a conductive wrist strap.
- Eliminate static generators (plastics, styrofoam, and so on) in the work area.
- Remove nylon or polyester jackets, roll up long sleeves, and remove or tie back loose hanging neckties, jewellery, and long hair.
- Store and transport all static sensitive components in ESD protective containers.
- Disconnect all power from the unit before ESD sensitive components are removed or inserted, unless noted.
- Use a static safeguarded workstation, which can be set up by using an anti-static kit (Motorola part number 0180386A82). This kit includes a wrist strap, two ground cords, a static control table mat, and a static control floor mat.

The Motorola part number for a replacement wrist strap that connects to the tablemat is 4280385A59.

- When anti-static facilities are unavailable, use the following technique to minimize the chance of damaging the equipment:
- Let the static sensitive component rest on a conductive surface when you are not holding it.
- When setting down or picking up the static sensitive component, make skin contact with a conductive work surface first and maintain this contact while handling the component.
- If possible, maintain relative humidity of 70-75% in development labs and service shops.

Note: G18 was tested for ESD according to EN 61000-4-2

CHAPTER 2 Model Description

This section describes the g18 integrated wireless modem (Figure2), including accessories, physical and electrical characteristics, features and functional capabilities, and the data-exchange network over which they communicate. This section also provides specific performance specifications.

For model numbers and languages supported see Annex A

Figure 2 - g18 data module

Introduction

The g18 modem is supporting two modes of operation
1. A Phase II + GSM class 4 embedded module package with voice, data, fax, and short message service (SMS) support.
2. GPRS module supporting Packed data communication in 900/1800/1900 MHz bands.
The g18 GPRS features will include full over-the-air Class B features using and handset with multi-slot Class 1,2 and 4. Additionally, CS1-CS4 GPRS Coding Schemes will be supported (Coding Schemes are used to manage the error rate in the transmission of data to the mobile).
If you have both RS232 and DSC bus interfacing g18, so you have the GPRS class B ability - or in other words, you can answer a voice call, while you in GPRS mode. It's the same as if you have a handset connected - it's also DSC bus.

The g18 is designed to support a range of subsidiary services associated with navigation, emergency services, road tolls, security systems such as car alarm, fire alarm, etc. as well as integrated standard voice / data/ GPRS communication. Applications where data modules can provide these benefits include automotive Telematics, mobile computing, asset management, remote utility meter reading, street light control, home security, vending and copy machine management, fleet management, ATM security, POS connectivity, household appliance monitoring and control, display systems, load management and many more. To support this flexibility, the same functionality is offered in several different configurations. GPS capability is also provided in an additional configuration.
The modem relies on system software for basic operational instructions and on configuration parameter values to meet modem and network interface requirements.

The g18 is designed for use in a system environment comprising a GSM mobile radio network with one or more radio operators per country. A corresponding infrastructure of a configuration level suitable for the use of terminal devices with two watts transmitting power is a basic requirement.

d15 compatibility with g18

The g18 was design to be compatible with the d15 with additional functionality of GPRS.
This paragraph is summarizing the differences between g18 and d15.

Table 2 - Differences Between D15 and g18

Function	D15	g18
General		
GSM Type	GSM Phase II+	GSM Phase II+ + GPRS
Data Levels	**Data signals at 5V.**	**Data signals at 3V. See details at Ph. 3.3.1**
Pin-out		
	Pin 15 in ZIF connector, Pin 10 in DIN connector "Port-out" - Not used	Pin 15 in ZIF connector, Pin 10 in DIN connector "wake-up line" (awake G18, Awake DTE, GPRS coverage) see details in Ch. 4.1.2
	Pin 2,3 in ZIF connector, Pin 16,15 in DIN connector - TX_EN &NU	Pin 2,3 in ZIF connector, Pin 16,15 in DIN used for 2nd UART TXD & RXD lines.
Mechanical		
Mechanical models	Standard, Slim(ZIF), DIN-Hor, DIN-Ver, GPS	Slim(ZIF), DIN-Hor, GPS
Power		
Current in Sleep mode	<10mA @ DRX2 <8mA @ DRX 9	<7.5mA @ DRX2 <4mA @ DRX 9 See details in Ph 3.1.2
On/Off pulse duration	<500mS	<700mS, See details in CH 4.1.1.1
Data options		
V42 bis	Support only in SoftGsm mode	Not supported
Transparent mode	Support only in SoftGsm mode	Supported
Fax class 1 & 2	Support only in SoftGsm mode	Fax class 1 using winfax
Wake unit from Sleep mode	Special sequence is needed in the application.	Different sequence than D15 see chapter 3.1.3
Baud rate setting	Not supported	Enabled from 300 to 57600 bps See AT+CBAUD. (Auto baud rate is available between 300 to 19200 bps).
DTR/DSR lines	DSR set ON after the DTE asserted DTR.	There is no dependency between the two lines.
AT Commands		
AT+FCLASS=8	Not Used but can be entered and returned by OK	0,1 Will be supported
ATD*99	Not Supported	Request GPRS service "D "(see Ch. 4.1.2)
ATD*100	Not Supported	Manual acceptance of a network request. (see Ch. 4.1.2)
At$	Not Supported	Supported
AT+CPOL	Not Supported	Supported (Preferred Operator List.)

AT+CIMI	Not Supported	IMSI Request
AT+CIP	Not Supported	AT command for IP primitives simulation. See Ph. 4.15
AT+CRSM	Not Supported	Supported (Restricted SIM access)
AT+CPBS	+CPBS:("FD","LD","ME","MT","SM","DD")	+CPBS:("FD","LD","ME","MT","SM","DD", “RC”, “MC”)
ATS97 Antenna detect	Not supported	Supported
ATS99	Not supported	• Supported. Is not saved in profile, and need to be re-establishing after power-up.
ATS100	Not supported	• Supported is not saved in profile, and need to be re-establish after power-up.
ATS101	Not supported	Will set wakeup line forever when x=1, and reset it when x=0. ats101? Will return current state. These operations are allowed only when factory bit is set. When parameters are wrong, or factory bit is not set, return an error.
AT+CBST	(000-002,004-007,012,014,065,066,068,070,071,075),(000),(001)	(000-002,004-007,065,066,068, 070,071),(000),(000-003)
AT+CGSN	Not supported	Supported
AT+CPWD	Not supported	Supported
AT+CRTT	Not supported	Select ring tone - Supported
CIEV: 8, x	Not supported	New indication for GPRS coverage
AT&C2	Not Supported	Supported
AT+GMI	Not Supported	Supported
AT+GMM	Not Supported	Supported
AT+GMR	Not Supported	Supported
AT+CLCC	Supported	Add "dialing" state, and non standard "released" state. Asynchronous answers are also allowed, by using at+clcc=1
AT +MTDTR	Not Supported	Supported for DTR line test command.
AT +MTCTS	Not Supported	Supported for CTS line test command.

AT +MCWAKE	Not Supported	Supported for DTE Wake line control command.
MMGL	Not Supported	Supported from SW version above E6.01.10
MMGR	Not Supported	Supported from SW version above E6.01.10
MMGA	Not Supported	Supported from SW version above E6.01.10
CMSS	Not Supported	Supported from SW version above E6.01.10
CMGL	Support list of all messages only	From SW version above E6.01.10 support list of messages for each status according to ETSI 07.05
GPRS AT Commands		
AT+CGDCONT	Not Supported	Supported
AT+CGQREQ	Not Supported	Supported
AT+CGQMIN	Not Supported	Supported
AT+CGATT	Not Supported	Supported
AT+CGACT	Not Supported	Supported
AT+CGCLASS	Not Supported	Supported

Basic Model Overview

2.1.1 g18 DV Slim:

This configuration is the smallest packaged module, which measures, 44.28 x 88.45 x 10.4 mm. See Figure 3.

Figure 3 - g18 DV Slim data module

2.1.2 g18 DV Board Only – Horizontal:

The horizontal Board only product provides the smallest volume with a horizontal connection. See figure 4

Figure 4 - g18 DV Board Only –Horizontal connections

2.1.3 g18 DVG /slim:

The DVG Slim configuration provides GPS (Global Positioning System) capability housed on the same package as the GSM Data module. This allows developers to save on integration space when location information is needed. (Figure 5)

Figure 5 - g18 DV GPS Data Module

CHAPTER 3 Design Considerations

When integrating a wireless modem, internal connections and placements are critical to a successful implementation. Specific attention must be paid to the following support mechanisms:

- DC power
- Audio considerations.
- Serial interface and control
- SIM card considerations
- ESD considerations
- Antenna Considerations
- Mechanical mounting
- Desense control (see “Desense” on Annex G)
- How to connect a 3788 handset to g18
- GPS Considerations.

Power supply consideration.

3.1.1 Power Supply losses.

The g18 is specified to operate from 3.0V to 6.0V on the g18 input (after the flat cable losses). In order to be able to work in the lowest battery values it is important to verify the losses in the power supplies lines, Flat cable and in the user PCB.
The g18 is a GSM phone that transmits in pulses of about 0.5mS every 4.6mS. The Peak current is about 1.5A.

The VCC line will drop down in the TX periods:

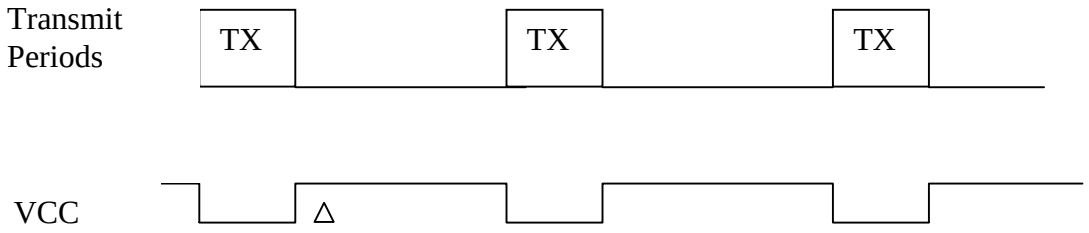


Figure 6 – The VCC signal during TX periods

In order to minimise the Δ it is recommended to use a short Flat cable as possible and to put a 1000uF capacitor (or maximum possible) in the g18 VCC input.

Note: In addition to the losses recommendation, it is recommended to have a current limit in the power supply (2.5-3A) in order to avoid damages in case of short.

3.1.2 Current consumption in g18

In order to design the power supply correctly you need to take in account the current consumption of the g18 in the different modes.

Table 3 – g18 Current consumption

Mode	Current consumption
g18 with no accessory when no call is in process (Sleep Mode)	<4mA @ DRX9. < 7.5mA @ DRX2.
g18 with no accessory but TS is ON	< 50mA.
g18 during searching time	<180mA typical average 80mA.
g18 with DSC bus accessory (like Handset) when no call is in process	Typical 45 mA.
g18 during a call in maximum power level	<1.8A Peak, Average 300mA @5V.
g18 during a call in GSM power level #10 (for Example)	<0.7A Peak, Average 175mA @ 5V.

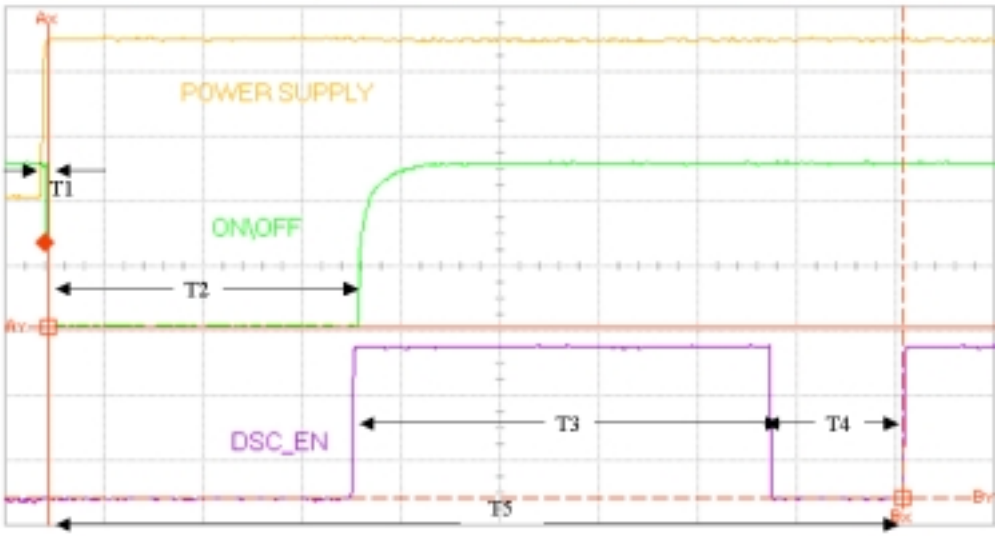
Note: DRX2/9 is the rate that the base station, interrogate the mobile station. The network operator sets this parameter.

3.1.2.1. Turn On/Off the unit

The g18 is powered from a single power supply in the range of 3.0 to 6.0 Vdc.
The unit will not power up automatically by connecting the power and there are two ways to turn the unit ON.

3.1.2.2. Turn ON/OFF the unit using the ON/OFF pin.

The ON/OFF pin (pin # 14 at the ZIF connector & pin # 18 at the DIN connector) is used as a toggle input to turn ON and OFF the unit. Any drop to ground in this pin will change the status.
To verify that the unit is ON or OFF you have to check the DSC_EN line, If it is high the unit is ON if it is low the unit is OFF.
The timing for this process is the follow:



T1 minimum = 12ms

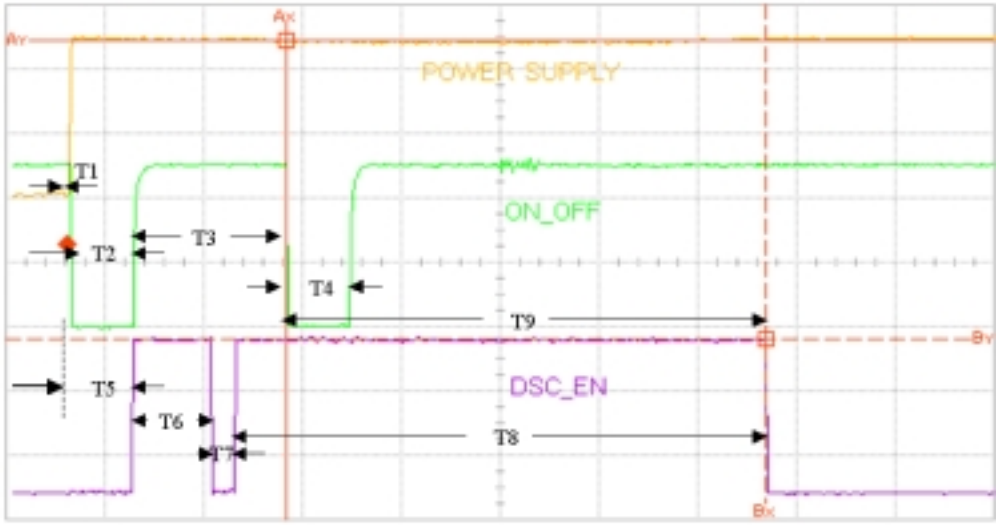
T2 minimum = 630ms

T3 typical = 850ms

T4 typical = 240ms
T3+T4 max =1300ms

T5 typical = 1725ms

Figure 7: Turn On the unit using the ON/OFF pin



T2 min = 630ms (T1 min = 12ms)

T3 min = 1550ms

T4 min = 630ms

T5 = 620ms

T6 = 800ms

T7 = 240ms

T8 = 5400ms

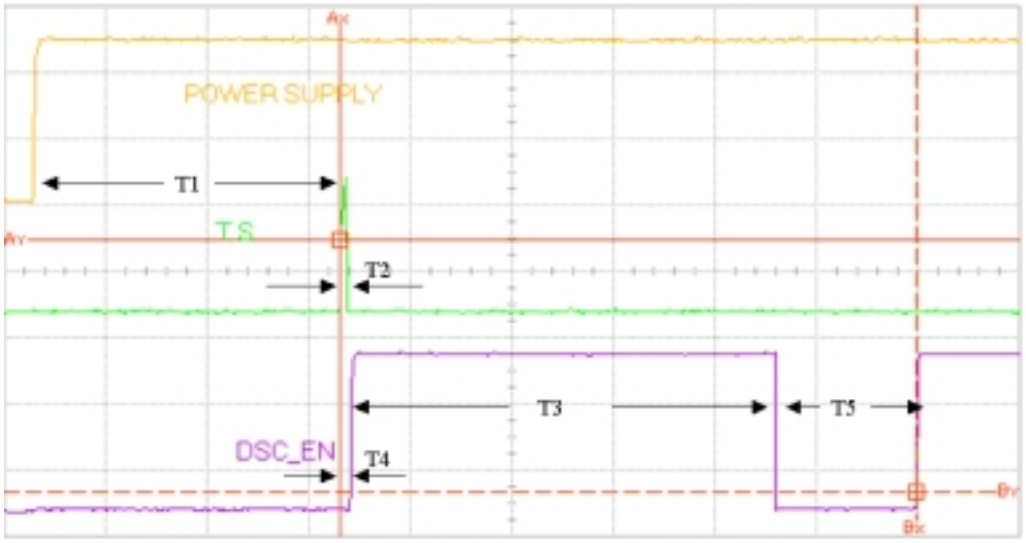
T9 = 4840ms

Figure 8: Turn On and Off the unit using the ON/OFF pin

3.1.2.3. Turn ON the unit using the TS pin.

The main used of the TS line is for units connected to a mobile device in which the current consumption is not the main concern.
The TS line is used to turn ON the unit. This line can't turn OFF the unit.
When this line is rise up it will turn ON the unit.
This line is used for example to turn ON the unit when power is connected to the unit. (Like Ignition line in a car kit).

Note - TS line should be return to low in order to be able to work in sleep mode.



T1=600ms (on is sent after the power was supplied for a long time 600ms)

T2=12ms (The TS signal is sampled on the rising edge, therefore it size does not matter)

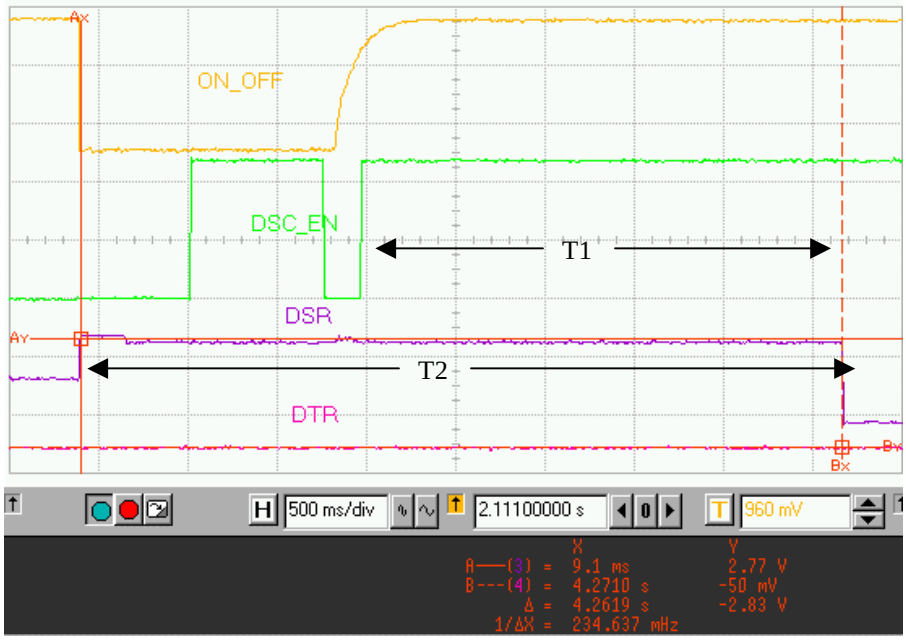
T3= 820ms

T4= 25ms

T5= 250ms

Figure 9: Turn ON the unit using the TS line

The following pictures show the behaviour of the RS232 lines during the turning on of the G18 (Low level on RS232 indicates active state).

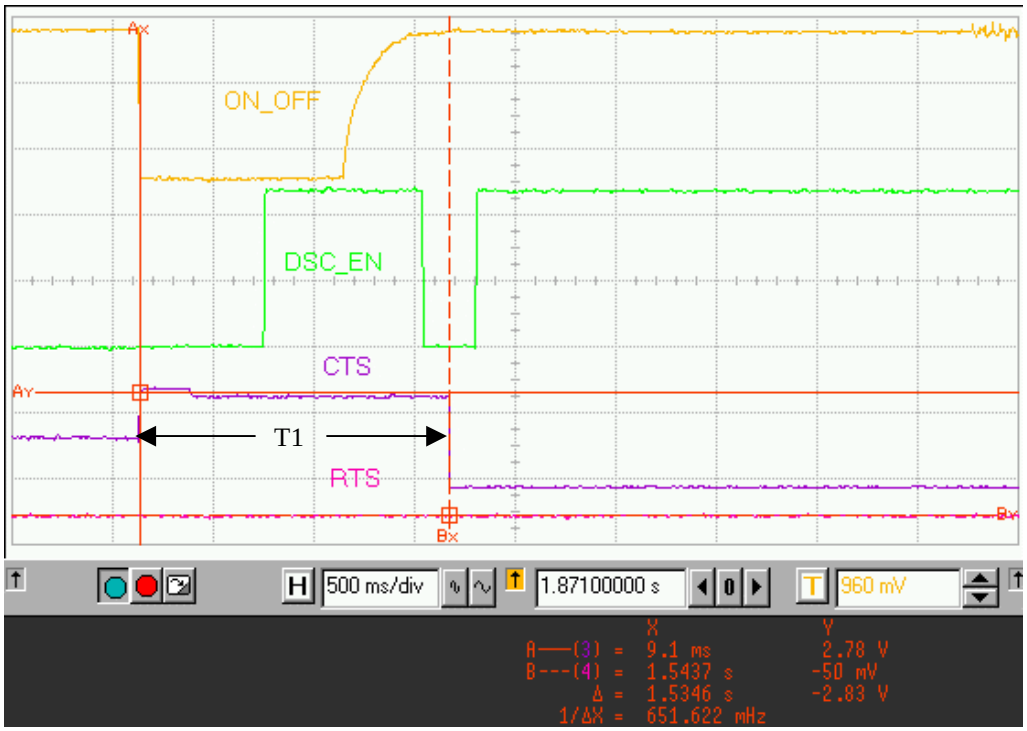


T1 max = 3.5 sec

T2 max = 5.5 sec

Figure10: DTR/DSR during Ton

The CTS becomes active before the DSC_EN becomes active.



T1 max = 1.7 sec

Figure11: RTS/CTS during Ton

The DCD and RI are inactive during the on/off process.

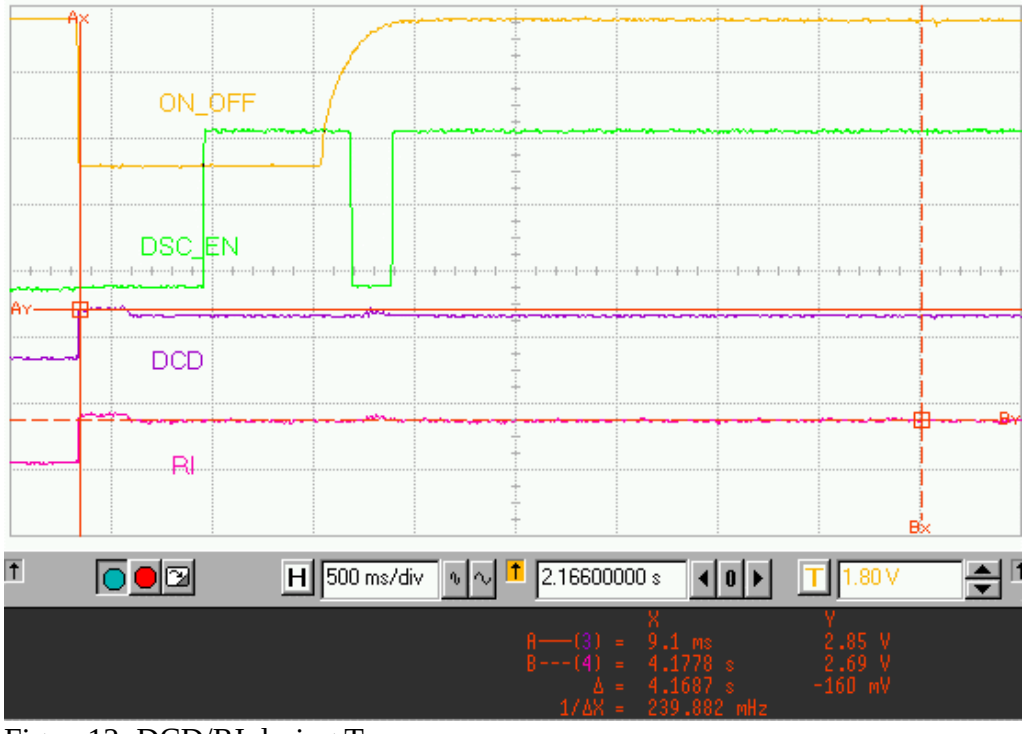
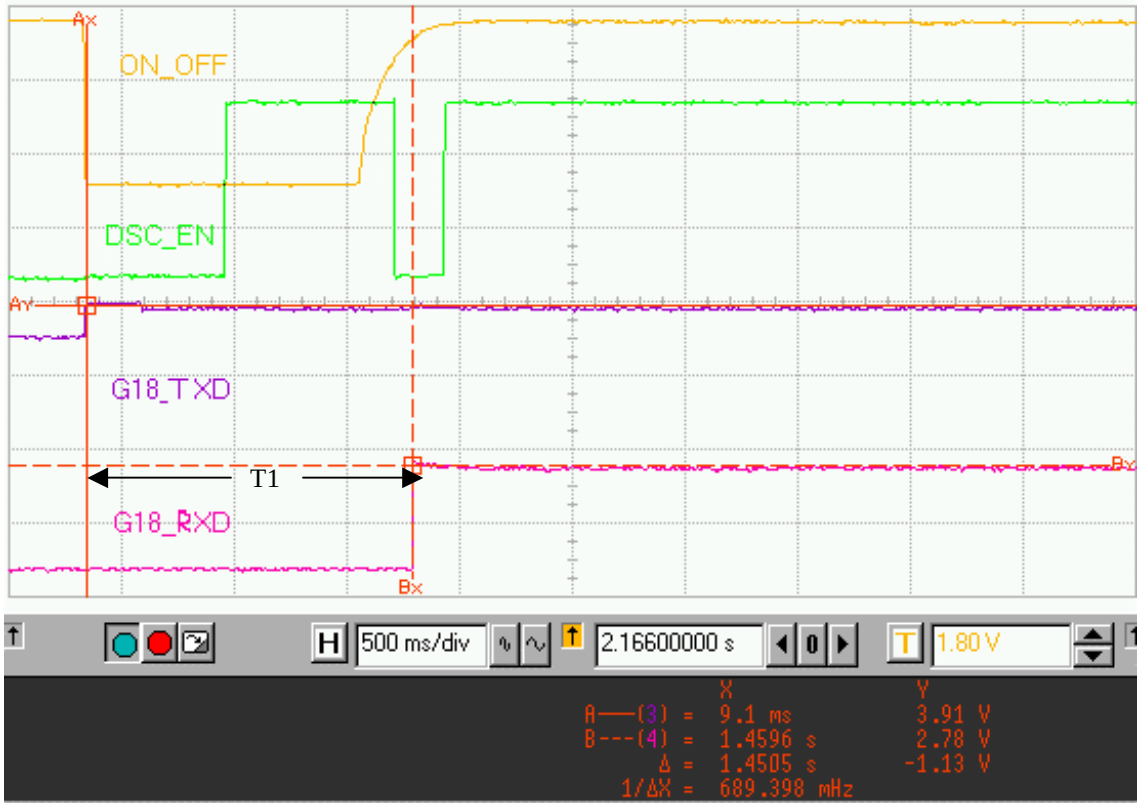


Figure12: DCD/RI during Ton



T1 max = 1.7 sec

Figure13: TXD/RXD during Ton

3.1.3 How / When to make the unit to wakeup

If the g18 has no accessories, g18 is able to go to sleep mode (current save mode).
In Sleep mode the radio is switched to minimum activity. The clock is removed from the RF section and it reduced from 13MHz to 32KHz in the Logic section.
The unit is sensing the activity by going out of this mode in a periodic sequence.
In any case of an incoming call the unit will go out of Sleep mode.
Going to sleep mode will not terminate a GPRS section and will not deactivate a context.
During sleep mode period the RS232 is not responding to any command from the DTE device (UART is disabled and no respond will be received via the RXD line). In order to wake up the unit, the host needs to communicate with the g18 as follow:

Two options will be available to wake the g18.

Option 1:

The sleep mode will work as follow:
At the beginning of you work activate the sleep mode by sending ATS24=n (n=1,2,3,4 seconds).
(To disable sleep mode send ATS24=0)
Then the scenario will be the follow:
The g18 will drop the CTS any time that the unit is in sleep.
When TXD is present the g18 will not go to sleep mode, After the end of the TXD (TXD buffer empty) the g18 will wait n seconds (like set in ATS24=n) and go to sleep.

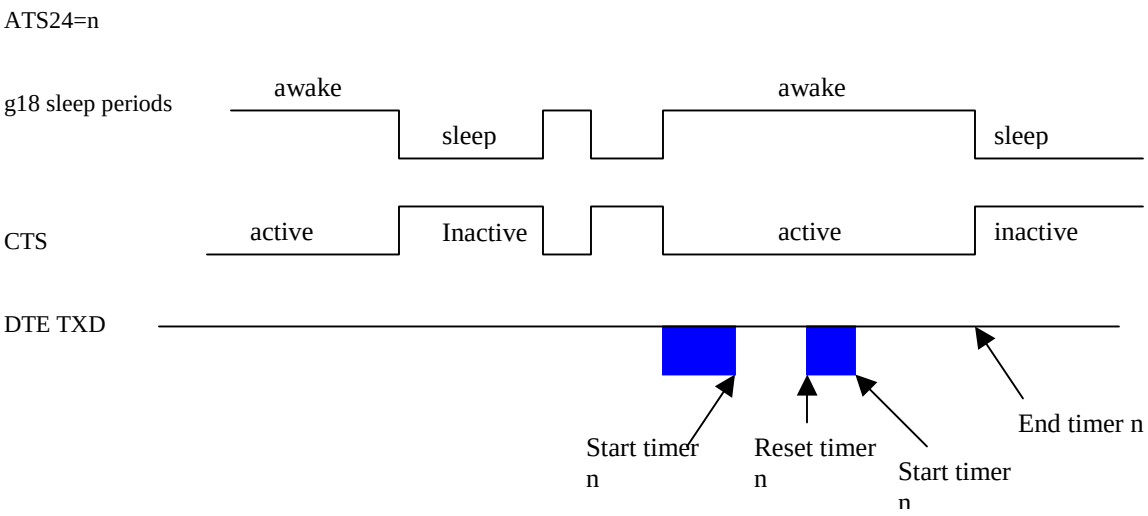


Figure 14: Sleep mode timing

NOTE:

1. ATS24 factory default value is "0" this value is saved in the EEprom . To change the default value you should save the new value to the EEprom. After recycling the power the value of S24 will be the value saved in the EEprom. The value of ATS24 can be changed also without saved in the EEprom but will be loosed after power recycling.
2. TS line should be low in order to be able to go to sleep mode.
3. DTE should look for active CTS before sending data (HW flow control).
4. DTE's UART should not send any character to g18, if CTS is inactive, otherwise that character might be lost. If the DTE's processor handles the flow control, and not its UART, and there is a gap between checking the CTS state and sending the start bit, g18 might set CTS inactive during this gap, and character send to g18 might be lost.

Option 2:

At the beginning of you work activate the sleep mode by sending ATS24=n (n=1,2,3,4 seconds).
Use the wake up line to wake the G18 any time that you like to send data.
The wake up line (pin # 15 at the FC 36 pin or pin # 10 at the DIN 28 pin) will be used for this purpose.
Any time that the DTE will want to send data he will pull this line to low, wait 30 ms (wake time required for the g18) and than can start to send data.
The wake up line should be remained low all the period of sending data, At this time g18 will not go to sleep.

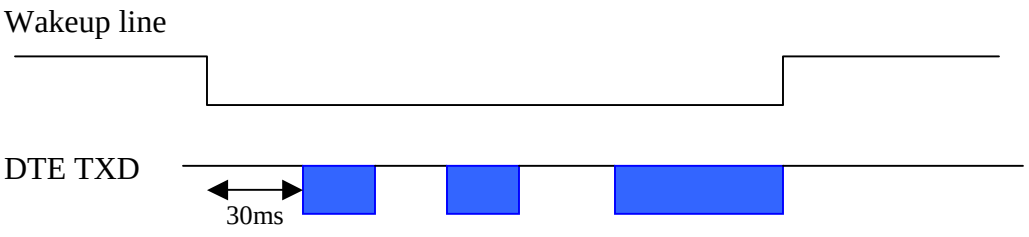


Fig.15 Wake the g18 when DTE want to send data.

Wake up the DTE:

The g18 is able to indicate the DTE that data is present or when the unit went out and came back from a GPRS coverage area.
This will be done using the bi-directional line - Wakeup line (pin # 15 at the FC 36 pin or pin # 10 at the DIN 28 pin)

When g18 wants to send data to DTE, g18 will activate the wakeup line to interrupt DTE, followed by data transmission (assuming RTS is active). After 2*y ms from activation (t = pulse duration), g18 will deactivate that line. The value of y is determined by ATS99=t (default value is 30).

G18 toggles wakeup line once, before sending the first character to DTE, when previous character was sent more than T seconds before that. The value of T is determined by an ATS100=T (default value is 1).

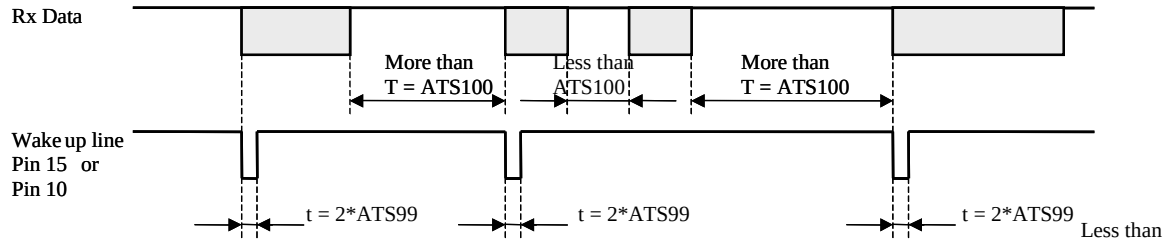


Figure 16: **Wake the DTE when Data is present using the wakeup line**

- Wake up the DTE when unit is going from state of non-GPRS coverage to GPRS coverage.

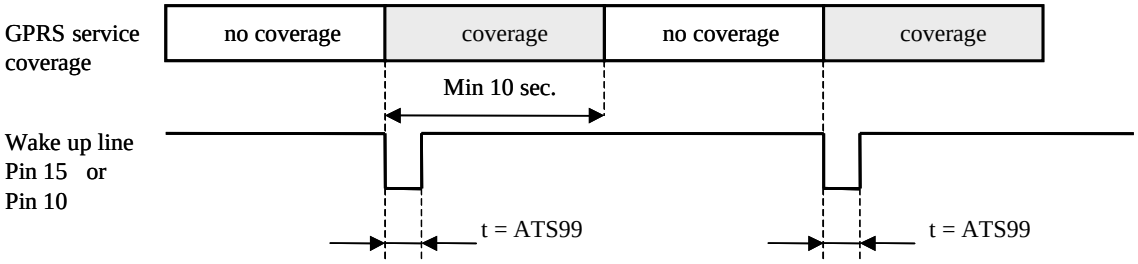


Figure 17: **Wake up the DTE when unit is going from state of non-GPRS coverage to GPRS coverage**

Note: 1. The g18 will give a wakeup pulse for data sent to DTE in GPRS mode and in CSD mode.
2. The g18 will generate a wake up pulse whenever asynchronous data is sent to DTE.
(+CIEV, +CLCC, +CCWA, +CMT, +CMTI, +CBM, +CDS, +CDEV, +CLIP, +CR, +CREG, +CIP, 2 / RING …)
3. The g18 will give a wakeup pulse whenever a change in GPRS coverage occurs, depends on dynamically setting of AT+CWAKE=N command:
   - N = 0: Changes in GPRS coverage will not generate a wakeup pulse.
   - N = 1: When GPRS coverage is lost, g18 will generate a wakeup pulse.
   - N = 2: When GPRS coverage achieved, g18 will generate a wakeup pulse. This is the default value after power-up.
4. S99 responds with error if the value is greater than 2,147,483,647. Value of 0 is changed to 1, No error on that.
5. S100 responds with error if value is grater than 32,767. Value of 0 is changed to 1, No error on that.

Wake up line architecture:

The wake up line is a bi-directional line. It is used to turn on the G18 as described in Option 2 (input to G18) and to wake the DTE (output from G18).

The configuration of the line is the follow:

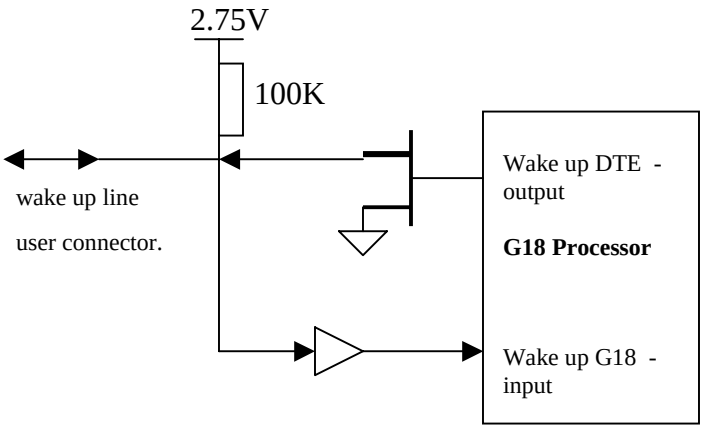


Figure18: Wake up internal connections

The user need to put attention to the following points:

1. When the wake up line is used to wake the G18 (wake up line is pulled down) no wake up indication to the DTE will be available.

2. When DTE is going to sleep mode the DTE should not load the wake up line (3 state).

Audio circuits consideration.

The g18 is able to make a voice call as well as Data calls. In voice calls the audio can be routed in a few channels:
Digital audio channel - Audio is sent via the DSC bus.
Analog audio channel - Drive externally to audio devices.
Analog audio channel in Hands free mode - g18 send the audio out with the Echo cancelling ON in the DSP, External drivers is required.

3.1.4 Digital audio.

In case of digital audio channel a DSC drives is in used. The consideration that should be taken in this case is to be aware of the present of the hook switch. The hook switch will distinguish if the handset is In/Out of use.
There are two DSC bus accessories for audio defined for the g18:

1. External Handset.
2. DHFA - Car Kit for Hands Free.

3.1.5 Analog Audio without Hands free.

The g18 will drive the audio out/in in order to allow a voice call. In order to connect a Headset it is needed to amplify the speaker and microphone channels,
An example for these drivers can be seen in Annex C EV board.

Other point to be taken in consideration is the Buzz noise existing in GSM phones due to the transmission rate (217Hz). In order to minimise this noise the g18 have a separate ground for the analog circuits.

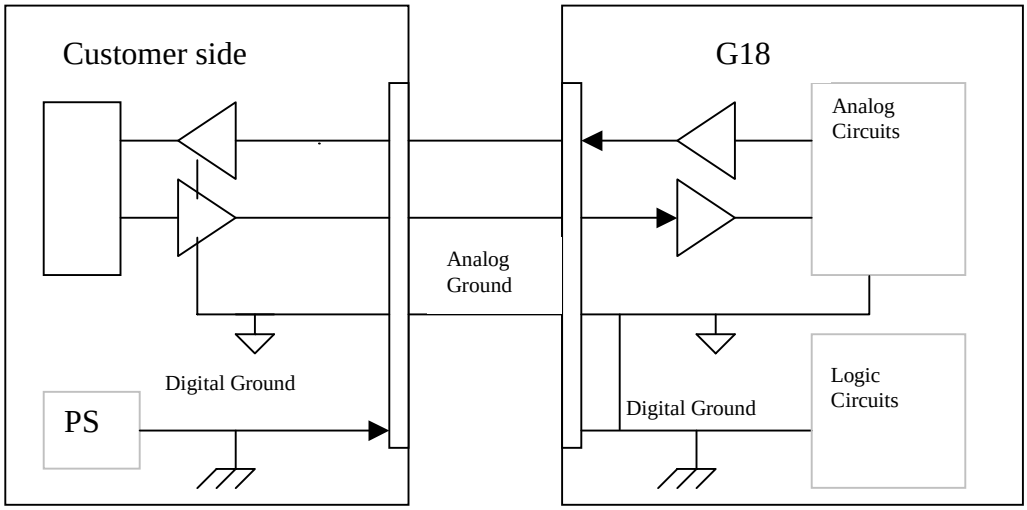


Figure 19 – Ground connections

The main problem causing the Buzz is drops in the Ground line because the peak current during TX mode. In order to minimize the Buzz the following acts should be done:

- Use short Flat cable.
- Connect the analog ground from the g18 to all the analog circuits in the customer application without connecting them to the power supply ground.
- All the capacitors to ground in the audio circuits should be connected to the analog ground.
- Any reference voltage that may be used should have the external capacitor connected to the analog ground.
- The maximal audio In/Out levels from/To the g18 can be seen below.
- Connect Digital ground to the Antenna ground. (this can help also if there is sensitivity desense due to digital signals from the used board).
- Connect the Digital ground of the g18 with the Digital ground of the Application.
- Verify that any of the Analog lines is not referenced to the Digital ground.

3.1.6 Analog Audio – Levels

Audio Uplink (MIC)
The maximum signal level that the g18 can receive in the Audio In pin, before the signal will be saturated is:

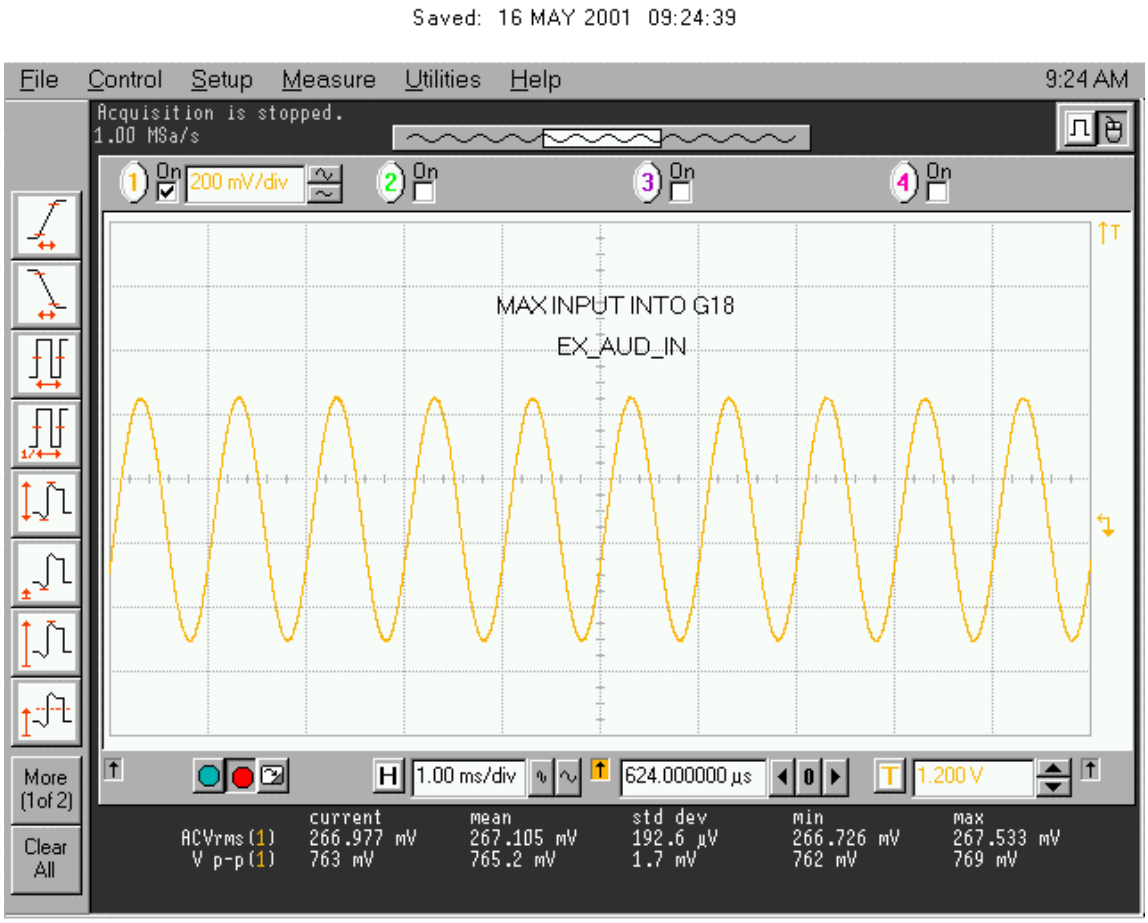

Saved: 16 MAY 2001 09:24:39
File Control Setup Measure Utilities Help 9:24 AM
Acquisition is stopped.
1.00 MSa/s
200 mV/div
MAX INPUT INTO G18
EX_AUD_IN
1.00 ms/div
624.000000 µs
1.200 V
More (1 of 2)
Clear All
current mean std dev min max
ACVrms(1) 266.977 mV 267.105 mV 192.6 µV 266.726 mV 267.533 mV
V p-p(1) 763 mV 765.2 mV 1.7 mV 762 mV 769 mV

Figure 20 – g18 Input maximum level

The maximum level that the G18 can accept before the signal at the network becomes distorted is about 500mvP-P.
The following picture shows this maximum signal:

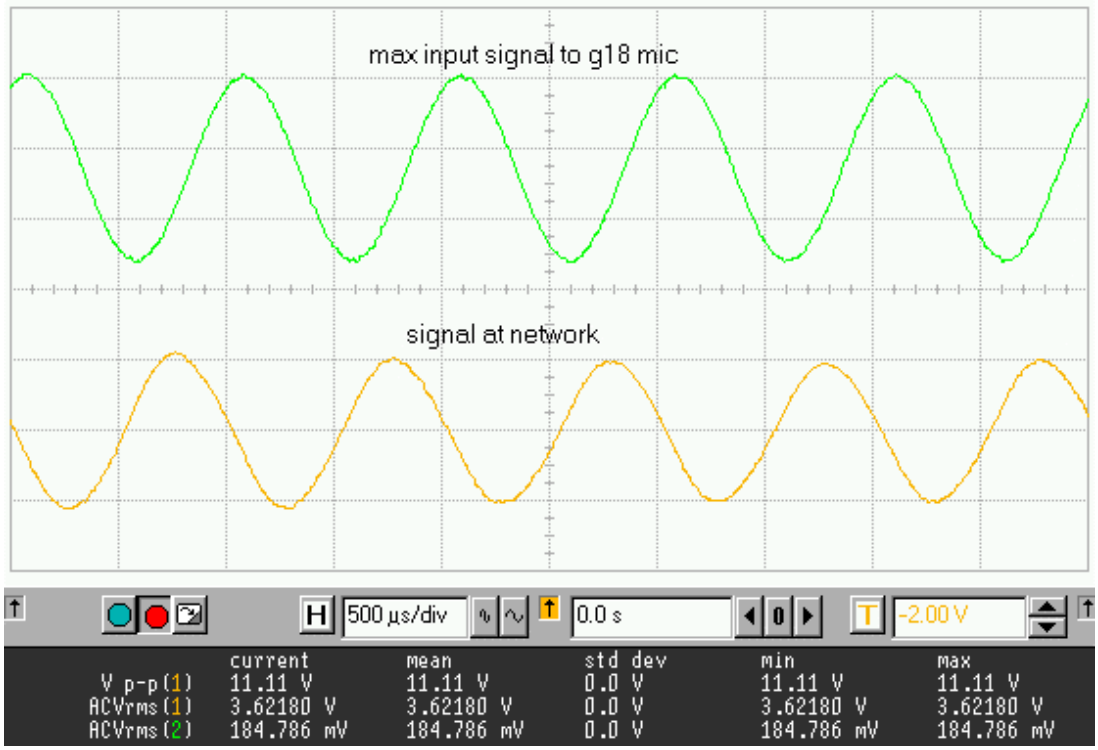

max input signal to g18 mic
signal at network
H
500 µs/div
0.0 s
T
-2.00 V
current mean std dev min max
V p-p(1) 11.11 V 11.11 V 0.0 V 11.11 V 11.11 V
ACVrms(1) 3.62180 V 3.62180 V 0.0 V 3.62180 V 3.62180 V
ACVrms(2) 184.786 mV 184.786 mV 0.0 V 184.786 mV 184.786 mV

Figure 21 – g18 Input maximum level and BS detected signal

The CODEC 0dbm0 = 375mvrms = 1058mvP-P

Between the EX_AUDIO_IN pin to the CODEC there is an amplifier with an amplification of 3.3 and the following frequency response:

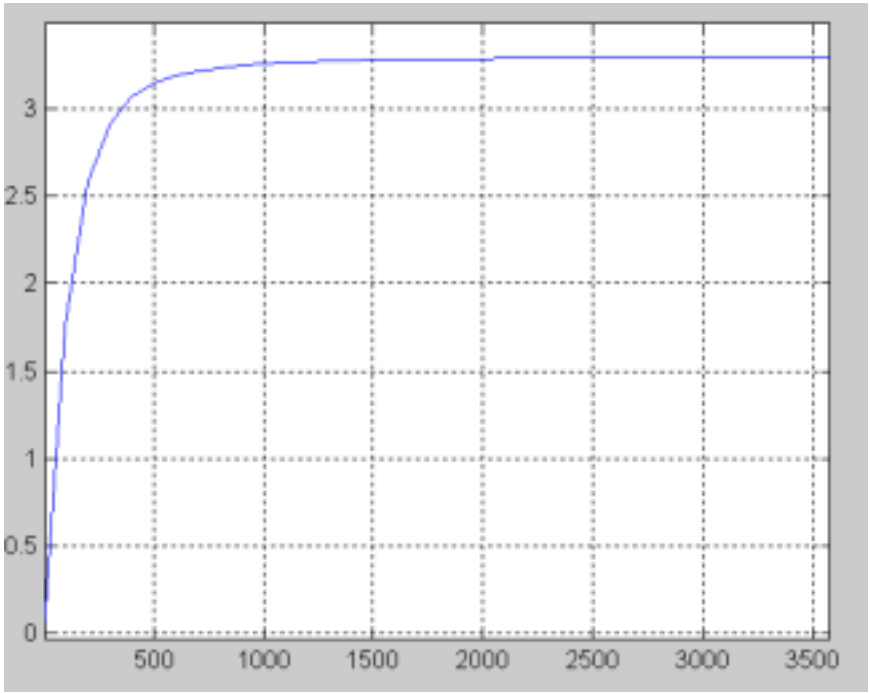


Figure 22 – Gcap amplifier gain response

Therefore the odbm0 of the uplink path is 375/3.3 = 113.63 mV RMS

The headroom is 20*LOG (500/(1058/3.3))= +3.86 dbm0

Audio Downlink (Speaker)

The 0dbm0 is 548mV RMS.

Max output is 2.6V p-p.

The maximum signal from the network before distortions occur was measured to be 1180mvRMS.

Therefore the headroom is 20*LOG (1180/548)= 6.66 dbm0

The following graph shows the frequency response of the analogue section:

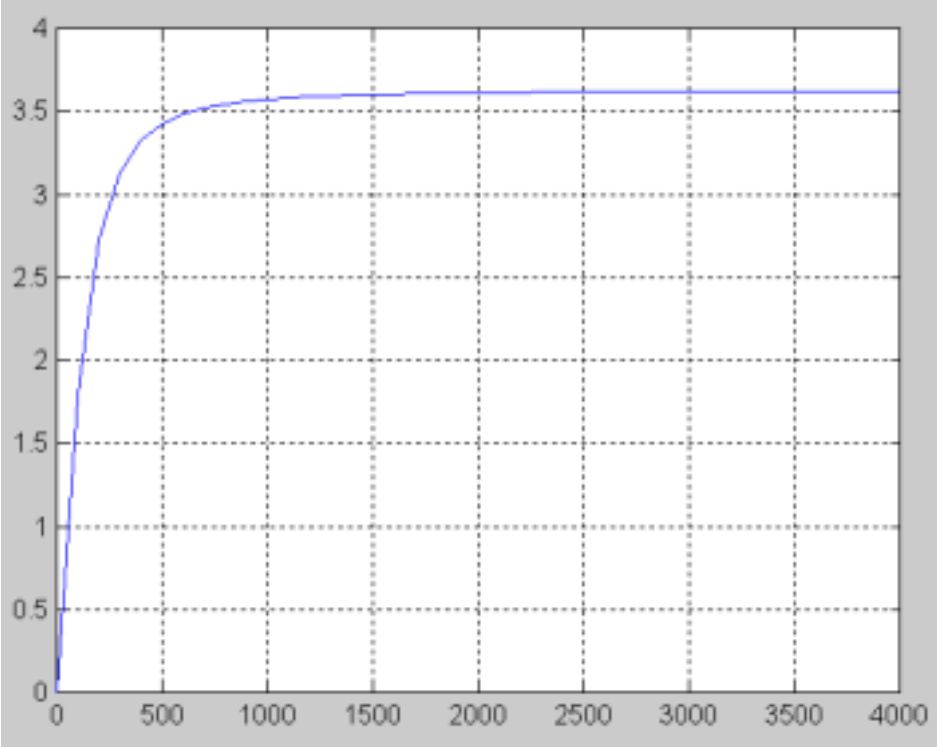


Figure 23 – g18 analog audio frequency response (Audio Out pin)

Voice

A 500mv RMS sin signal with a frequency of 1khz was sent from a base station to the G18.
The following amplitudes were measured on the audio out pin of the G18:

Handset volume	Amplitude (mV RMS)
0	27
1	37
2	51
3	69
4	100
5	137
6	196
7	277

Table 4 – g18 RX audio levels

Different levels were sent from the network and the signal was measured at the audio out.
The input is presented both in RMS and in dbm0. The output is at level 7.

dBm0	mV RMS	G18 Out (mV RMS)
3.14	1111.9	580
0	774.6	420
-5	435.6	237
-10	244.9	135
-15.5 (Phone: -4.7dBPa)	130	70
-16	122.8	68
-17	109.4	61
-20 (Dispatch: -94dBSP)	77.5	43
-25	43.6	24
-30	24.5	17

Table 5 – g18 RX audio levels Vs. different signals in the BS

Tones

The OK key was pressed and the tones were measured on the audio out pin of the G18.
The same amplitude was measured during a call, and off call. All the measurements are with ATS96=0

Handset volume	Amplitude (mV P-P)
0	43
1	75
2	107
3	150
4	215
4	215
5	295
6	420
7	583

Table 6 – g18 RX audio levels with ATS96=1

With the ATS96=1 command the amplitude was 1043 mV P-P

3.1.7 Analog audio with hands free

The audio In/Out from the g18 for analog Hands free is the same as for non-Hands free. All the consideration from Paragraph 3.2.2 is applicable for this mode too.
The additional consideration in this case is to switch the g18 DSP to Echo cancelling mode.
In order to switch to hands free mode use the RS232 port by sending a switch command at the start up.
ATS96=1 Echo canceller is activate. (Hands free)
ATS96=0 Echo canceller is disabled. (Headset - Default)
But during an active call the echo canceller can be activate but not disabled.

The block diagram for the required drivers are shown below, But detailed example of drivers design you can see the Evaluation board design, Annex C

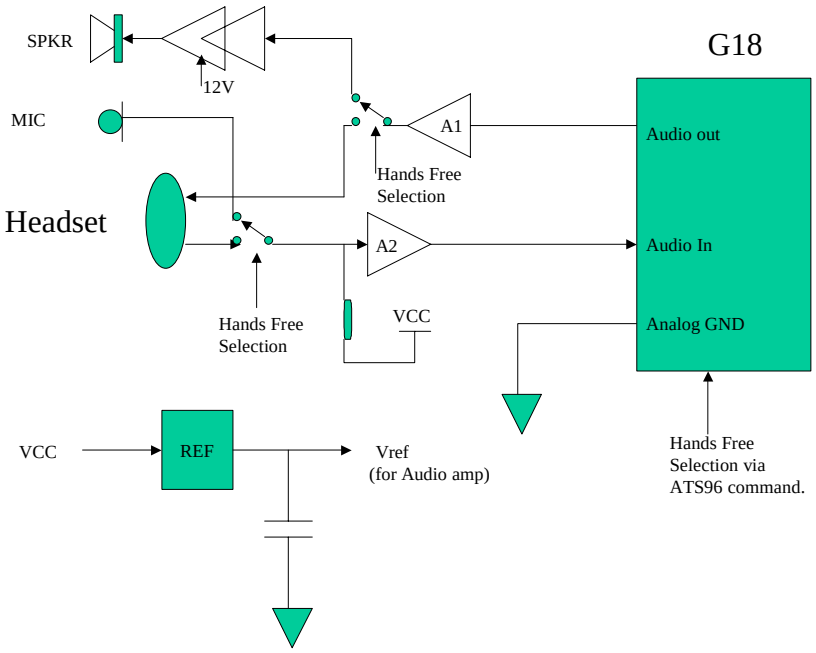


Figure 24 – EV audio block diagram

The requirements from the external drivers and audio devices are the follow:

Microphone impedance:	Typical 700Ω
S/N ratio	Minimum 35dB
Gain from headset to g18 (A2)	45 – 49 dB
Frequency response (including microphone)	-11 to +1 dB 300 to 3400Hz.
g18 input impedance	10KΩ
TX Distortion	Maximum 5%.
Speakerphone Load	25 to 39 ohm
S/N	Minimum 35dB
Gain from g18 to Headset (A1)	-13 to –9 dB
Frequency response (including SPKR)	-10 to +1 dB 300 to 3400Hz.
g18 output impedance	<1KΩ

Distortion	Maximum 5%.

Data port considerations.

3.1.8 Data levels.

The g18 is a **DCE** device operating in 0 to 3V logic. An MC74LCX244 buffer buffers all the In/Out signals.
DTR, DSR, RTS, CTS, DCD lines are "1" (active) in 0V and "0" (inactive) in 3V.
RXD, TXD lines are "1" in 0V and "0" in 3V.
The signal thresholds are:

Vih	2.0 V min, 5.5 V max
Vil	0.8 V max
Voh	2.5 V min @100 uA
Vol	0.2 V max @ 100 uA

Port configuration:

1 start bit
1 stop bit
8 data bits
No parity
Default Baud rate 9600bps with auto baud detect activated.
Specific baud rate can be set using AT+CBAUD=<Baud>

When a DTE is connected to the g18 (DCE device)

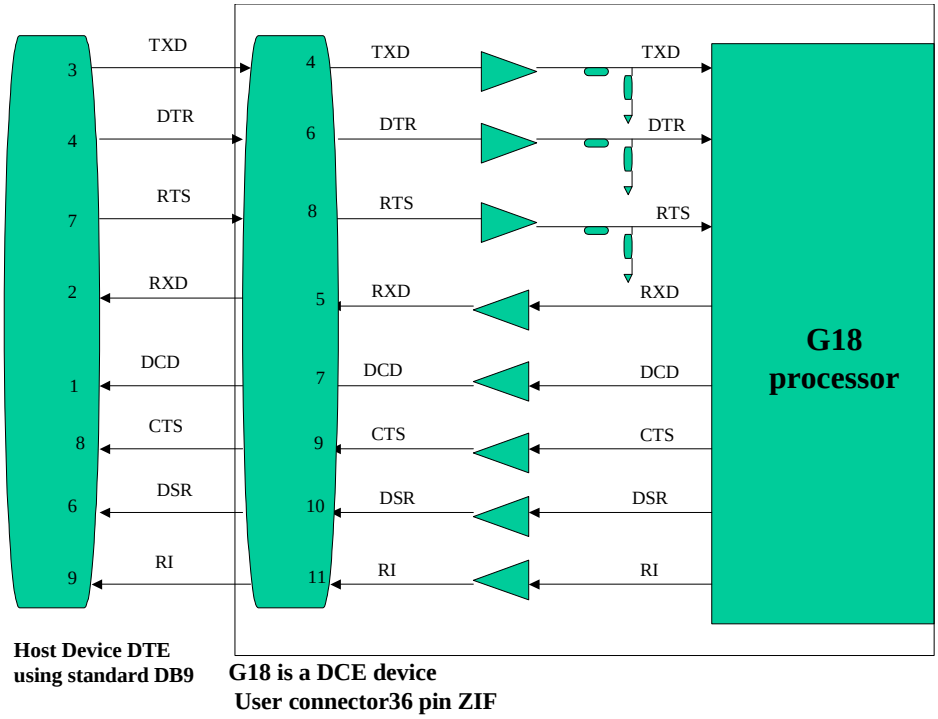


figure 25 – DTE connection to g18 (user connector 36 pin ZIF)

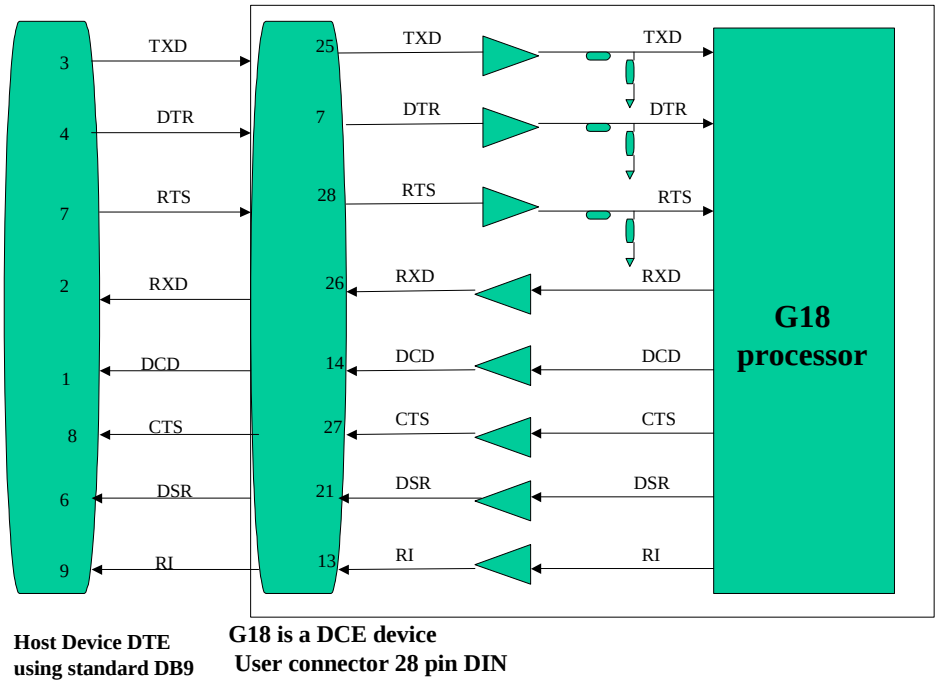


Figure 26- DTE connection to g18 (user connector 28 pin DIN)

When a DCE is connected to the g18 (DCE device)

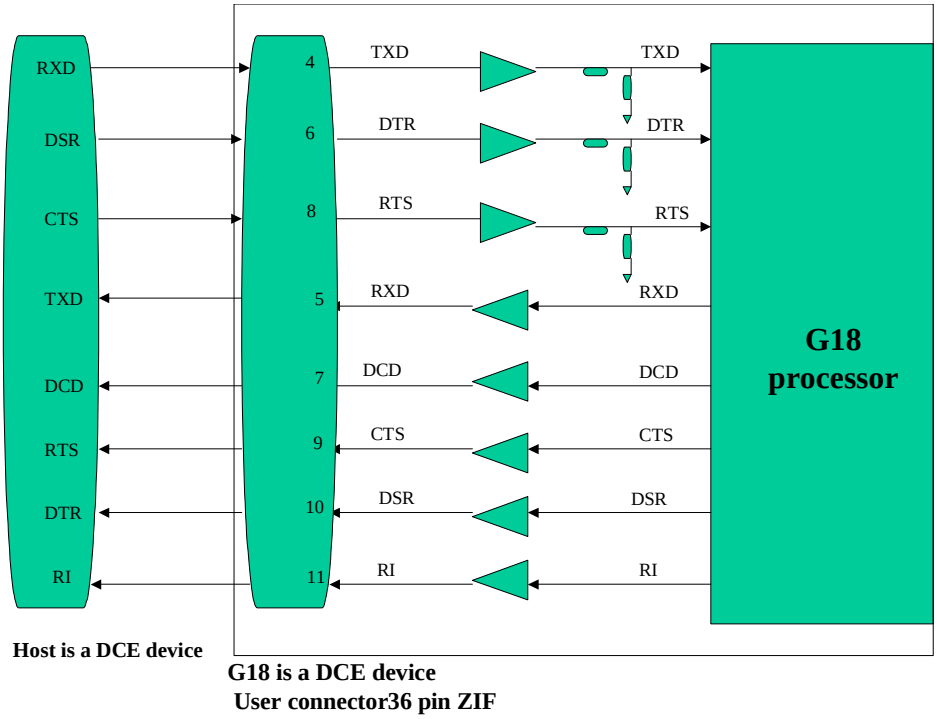


Figure 27- DCE connection to g18 (user connector 36 pin ZIF)

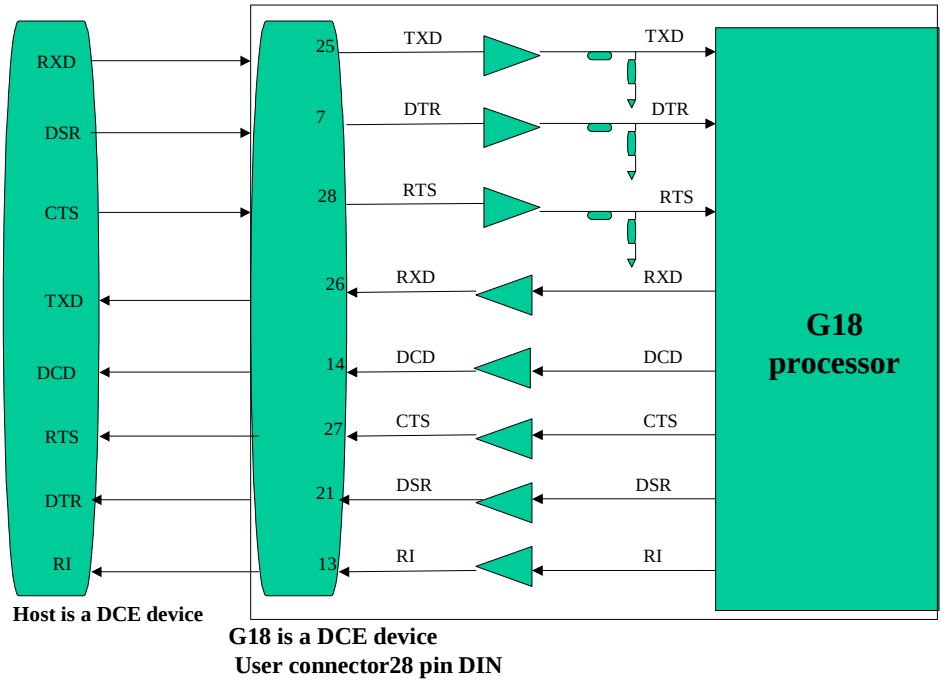


Figure 28 - DCE connection to g18 (user connector 28 pin DIN)

Note: When G18 is in sleep mode period the RS232 output lines are keeping the last stage. There are no level changes due to the sleep stage of the unit.

3.1.9 DTR line & DCD line.

The DTR line must to be active (0V) in order to recognize the DTE by the g18.
If the DTR is not used by the application connect this line to ground (DTR Active).

The DCD line will indicate the follow:

In CSD	Indicate Carrier Detect Low during the call high in idle.
In GPRS mode	Indicate PDP context status - Active low, Inactive high

DCD will be activated only when PDP context is achieved.
DCD will be de-activated when PDP context is off.
When g18 is used in PC the DCD will be off when PDP context is achieved due to the PC dialler.

Note:
DTR indicates that DTE is ready; DSR indicates that DCE is ready. There are no connections between the two.

3.1.10 Setting Baud Rate

Power up default baud rate is 9600, with enable auto baud rate detection feature. Baud rate can be switched to 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 using AT+CBAUD = <baud>.

<baud> values are 0-8, 9 or 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600. Values 0-8 represents 300 to 57600. Value 9 represents auto baud rate detection. For example, AT+CBAUD=8 is equivalent to AT+CBAUD=57600. Using AT+CBAUD=<baud> with <baud> value other than 9, will disable auto baud rate detection feature.

After power up, g18 UART is programmed to 9600, with automatic baud rate detection. To switch to 57600 BPS use AT+CBAUD=57600. g18 will replay with “OK<CR><LF>”. After flushing these characters out of the UART, g18 will re-program the UART to the new baud rate.

To verify this process, DTE’s UART should switch to the new baud rate after receiving “OK<CR><LF>”, and send AT+CBAUD? To get the new baud rate.
The answer “OK<CR><LF>” does not depend of ATVx setting (verbal or numeric response).

G18 supports auto baud rate detection for low baud rates 300 - 19200. To switch to that mode, AT+CBAUD=9 command should be sent to g18. g18 will process this command as described above, except that it will program UART to 9600 with auto baud rate detection. After getting the “OK<CR><LF>” DTE can program its UART to baud rate in range 300 -19200, and verify the new setup using AT+CBAUD?.

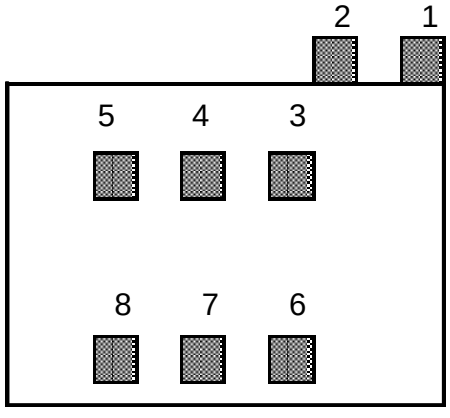
SIM lines consideration.

3.1.11 SIM Card Support

The g18 module has a built-in SIM card reader within the module itself. The SIM card is inserted into the slot provided on the side of the sheet plastic cover. When inserted to the correct depth the card should be flush with the cover. To extract the card, insert a non-conductive tuning tool into the slot on the top of the unit at the back end of the card, and then push the card out of the slot so that it can be removed by hand.

For some installations, this built-in slot will not be accessible, so an external card reader is needed. If a digital handset is going to be used, the card reader can be part of the handset and is connected to the modem via the DSC interface. Other installations require that the SIM card slot is installed into the OEM device and circuitry is installed to connect the card reader to the g18.

The SIM card interface contains six lines plus 2 lines for presence detect, which are lines 1 and 2 as shown in figure 20.



Pin	Description
1	Gnd
2	SIM_PD
3	SIM_CLK
4	.*SIM_RST
5	VSIM1
6	SIM_I_O
7	SIM_-5V
8	Gnd

Figure 29 – The SIM card interface

The g18 is supporting 3 types of SIM connection:

Internal SIM - Internal socket in the g18 - Support 3/5V cards.

External SIM - The SIM lines are routed in parallel to the SIM socket and to the user connector. The user can connect the SIM externally.
IMPORTANT !!
In case of externally connection the customer concern should be for Full Type Approval that may require submission for testing in case that the SIM lines will be longer than 10cm. Support 3/5V cards.

Remote SIM - This is a standard connection. The SIM is connected to an external SIM socket connected to the radio via the DSC bus. Two accessories exist - M3788 handset and external SIM card reader. Support 5V card only.

Note: Be aware that for GPRS your SIM card should support this service.

ESD consideration

In general the ESD can be protected up to 8KV by using ceramic capacitors of 0.1uF or higher.

- For all the static lines - power, SIM PD, SIM VCC, ... the capacitor will protect against ESD. The protection was done inside the g18, but it is recommended to add protection in the user PCB, especially if the flat cable is long.
- For lines with high rate of signals it is recommended to use Transguard with low capacitance. There are Transguard of 3pF or less.
- It is recommended to ground the antenna ground contact and the power supply ground contact in order to prevent ESD to go inside the g18 or user equipment.

Antennas

The antenna must be mounted like any other cellular or land mobile radio antenna. The best position for the antenna is usually the center of the vehicle roof, which provides a good fairly symmetric ground plane on metal cars. For vehicles that are fabricated of non-metallic material such as fibreglass, mount the antenna where it won't be obstructed by items such as mirrors.

3.1.12 Antenna Systems

Use this information to assist you in selecting the appropriate antenna to incorporate into your product package. For specific detailed information, Motorola recommends that you use the expertise of an antenna design engineer to solve individual application concerns.

3.1.13 Antenna Safety

The following statement from the American National Standards Institute (ANSI) specifies the safety criteria that integrators must use when designing the antenna for a product integrating the g18modem.
"The design of the integrated product must be such that the location used and other particulars of the antenna comply with the then current American National Standards Institute (ANSI) Guidelines concerning Radio frequency Energy Exposure and with any other nationally recognized radio frequency standards that may be applicable thereto. "

3.1.13.1. User Operation

Do not operate your telephone when a person is within 8 inches (20 centimetres) of the antenna. A person or object within 8 inches (20 centimetres) of the antenna could impair call quality and may cause the phone to operate at a higher power level than necessary and expose that person to RF energy in excess of that established by the FCC RF Exposure Guidelines.

CAUTION ! The telephone must be installed in a manner that provides a minimum separation distance of 20 cm or more between the antenna and persons to satisfy FCC RF exposure requirements for mobile transmitting devices

NOTE: **To comply with the FCC RF exposure limits and satisfy the categorical exclusion requirements for mobile transmitters, the following requirements must be met:**
A minimum separation distance of 20 cm must be maintained between the antenna and all persons.
The transmitter effective radiated power must be less than 3.0 Watts ERP (4.9 Watts or 36.9 dBm EIRP). This requires that the combination of antenna gain and feed line loss does not exceed 16 dBi.

3.1.14 Antenna Performance

The network operator usually sets antenna network requirements.

3.1.15 Portable Devices

In the environment where portable devices are in use, many variables exist that can affect the transmission path. In this case, it is preferable to use a vertically-polarized, omni directional antenna.
Antennas for portable devices include the following designs:

3.1.15.1. Internal antenna (invisible or pull-up)

This is the most difficult antenna design scenario. Despite greater physical constraints, an internal antenna must still provide a gain sufficient to meet network specifications. Metal cased products cannot have internal antennae as the metal acts as a shield around the antenna and prevents RF signals from reaching the antenna. I.E. A metal case acts like a Faraday cage. The antenna should be positioned so that it is vertically oriented when the device is carried normally. This will ensure that the best antenna performance is available most of the time.
Cable routing from the modem to the antenna needs to avoid RF-sensitive circuits and high-level, high-speed clock circuits. Consider these items:

- The location of the antenna to avoid RFI to a computing device
- Good shielding to the display and other RF-sensitive components
- The most efficient method of cable routing

Otherwise, antenna gain can be offset by cable loss. A typical coaxial cable is very thin, such as RG178B used in portable devices, and cable loss can be as high as 0.5 dB per foot. Some coaxial cable manufacturers market relatively thin double-braid coaxial cables. These cables show much better isolation than single-braid cables, typically by 30 to 40 dB. These double-braid cables reduce radiation and RF pick-up when routed inside a portable device.

3.1.15.2. External antenna, removable and directly connected to the device

You can design a portable device that can use an off-the-shelf, plug-in antenna, such as a 1/4 wave monopole or 1/2 wave dipole antenna. Typical gain of these omni directional antennas is 0 dBi and 2.14 dBi, respectively. Like the internal antenna, these antennae should be oriented vertically when the device is normally carried to ensure the best antenna performance.
Cabling demands the same consideration as an internal antenna application. In a typical laptop application, the antenna must be placed as far as possible from the display to avoid deflection. This usually causes a deep null in radiation patterns.

3.1.15.3. External, remote antenna

For remote antenna application use the same design approach as internal designs, including the RF cable routing of the external connector. You can choose an off-the-off the shelf mobile antenna of omni directional 1/2 wave length. The antenna has 2.14 dBi of gain. Higher gain than that might not be appropriate for portable applications.
A double-braid coaxial cable such as RG223 from the device to the antenna is recommended if the cable length is more than a few feet. The difference in cable loss between low-cost RG58 cable and the more expensive RG223 cable is approximately 4.5 dB per 100 feet. If the cable must be routed through noisy EMI/RFI environments, a double-braid cable such as RG223 can reduce radiation and pick-up by 30 to 40 dB.

3.1.16 Fixed Devices

Fixed data device applications use the same design recommendations as a portable device with a remote antenna.
As for the RF connector of an external antenna, whether it is a plug-in type or a remote type, the most economical and practical choice is a TNC threaded connector. TNC has a good frequency response to 7 GHz, and leakage is low. A mini UHF threaded connector provides adequate performance and is an economical choice. If the size of the TNC and mini UHF connectors becomes critical, consider an SMA threaded connector or an SMB snap fit connector. (The SMB connector does not accept RG58 or RG223 cables).

3.1.17 Antenna Test Methods

Whether portable or fixed, the device antenna is the critical link to the network. A poor performing antenna reduces the coverage of the device within the network footprint. The antenna performance must meet the impedance and match the criteria of the modem (see the modem specification), and have the appropriate amount of gain to meet the network ERP requirements.
Two tests must be performed on the antenna to ensure that it meets requirements. For both tests the antenna must be integrated in its final form. That is, the antenna must be mounted on a representative housing that includes all metal objects forming the ground plane or counterpoise.
Antenna testing requires an experienced operator and an anechoic chamber, a GTEM cell, or approved open field site. Your Motorola OEM support representative can provide advice on this type of testing.

Mechanics

Mounting the g18

3.1.18 Fixed-Mount Usage

Fixed-mount usage eliminates most of the mechanical constraints of handheld designs, although the requirements still apply. Fixed-mount units are sometimes AC-line powered and require filtering to eliminate the 60 Hz noise that can impair modem operation.
Proper mounting of the modem requires secure fastening of it within the host housing.
To ensure ease of access for installation and troubleshooting, locate the modem within the product in such a way that serial I/O and antenna connections are readily accessible.
Quick access to the modem allows it to be efficiently removed, probed, and functionally tested.

3.1.19 Fastening units with housing

Mount the modem to the rigid OEM product housing, using four #2-56 UNC 2A machine screws torqued to 2 in.-lbs. Position the screws as shown in Figures 5 and 6.

3.1.20 Fastening DIN units

Secure the DIN board to the host device using three M1.8 screws.

CAUTION ! **Do not mount a g18 integrated wireless modem in PC Card Type III rails. Forcing the modem into a PC Card header can damage the connector pins in the header and leave the modem loose and poorly grounded.**

Figure 30 - Mounting the modem (front view)

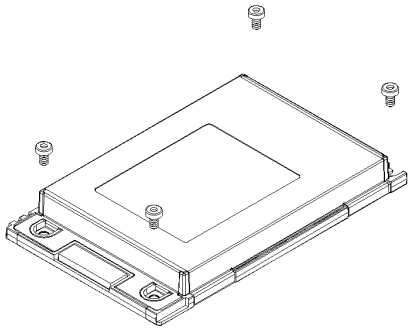
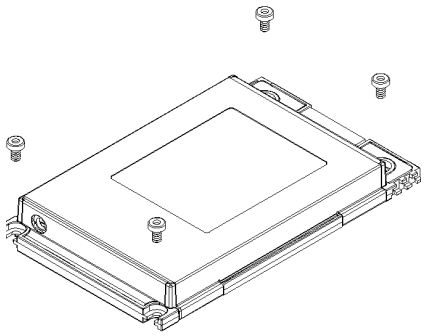


Figure 31 - Mounting the modem (rear view)



How to connect 3788 Handset to g18.

In order to connect the handset (3788) to the g18 there is a need of the following connections in the user board.
You can see below the circuits used in the g18 Evaluation board for this purpose as an example.

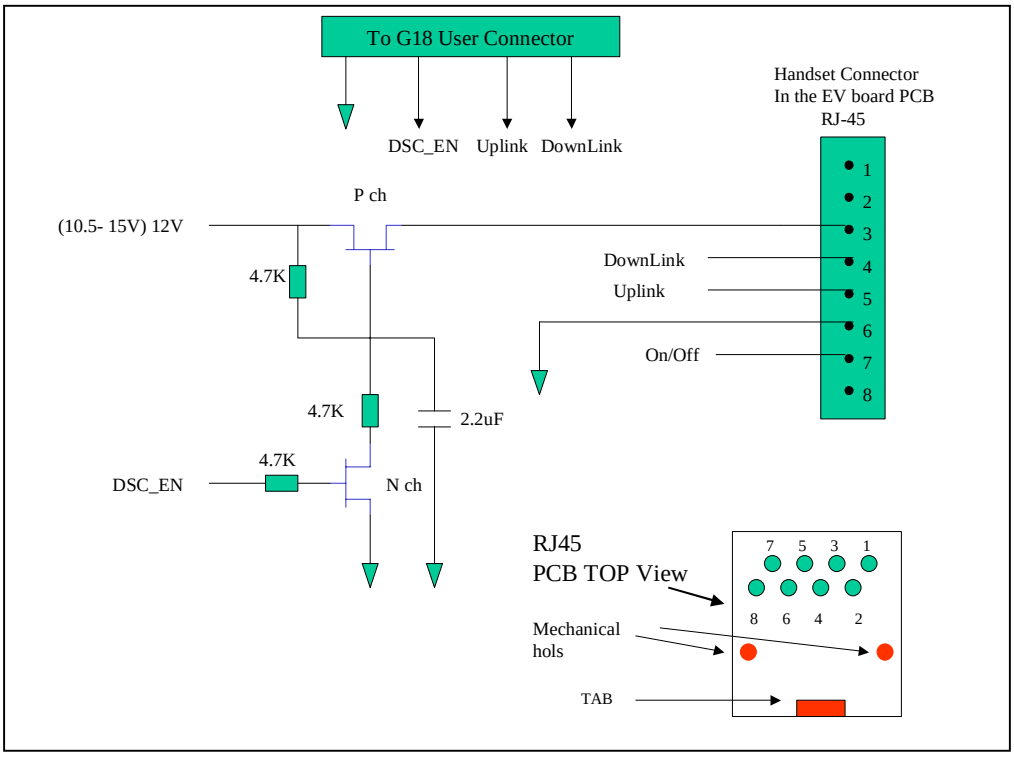


Figure 32– Handset Connections / HW required

GPS Considerations

The g18 DV with GPS model includes internally a M12 GPS receiver from Motorola.
The GPS receiver is powered internally from the g18 with 3Vdc.
All the other lines of the GPS were routed to the user connector (ZIF 36 pin).

The GPS lines in the g18 user connector 36 pin ZIF socket are as follows:

Table 7 – The GPS lines in the g18 (user connector 36 pin ZIF socket)

g18 User Connector Pin #	Function
2	GPS RXD receive data in 3V logic.
3	GPS TXD transmit data in 3V logic.
34	Antenna voltage input 3 or 5 Vdc. (active antennas)
35	RTCM input - 3V logic.
36	1pps output in 3V logic.

The GPS receiver is a stand-alone unit in the g18.
More details about the M12 module can be viewed on the web at
http://www.synergy-gps.com/M12_Oncore.html

CHAPTER 4 Software Interface

The operating functions of the g18 modem are implemented in the base unit in which the g18 is integrated. The g18 is a GSM900/1800/1900 Phase II+ device with GPRS capability.

The corresponding functions are implemented conforming V.25ter, GSM07.07, and GSM07.05. Note that the standards bodies regularly update these standards and so it cannot be promised that the commands supported by the g18 exactly conform to the latest versions of that specification. Some commands listed in these standards do not apply in the GSM environment.
AT+C commands conforming to GSM07.07 and GSM07.05 and a number of manufacturers-specific AT commands are available via the serial interface of the g18 for the implementation of the functionality.

Command input is via the operating functions of the base unit. The base unit translates the operating functions into AT commands and the g18 executes the requested action. **Note**: you should wait to OK before sending new AT command. The modem guidelines V.25ter are applicable in regards to the time sequence of interference commands. In accordance with this guideline, commands start with the string **AT** and end with a carriage return (<CR> or 0x0D). Commands are acknowledged with **OK** or **ERROR**. A command currently being processed will be interrupted by each subsequent incoming character, so the next command must not be sent until the acknowledgement has been received that command has been processed. Otherwise the current command will be cancelled.

Modem Communication Modes

The g18 modem supports the following communications modes:

Voice Communications

Analog Audio - Audio communications via a standard analog headset such as the headset used with the StarTAC cellular phone. In this case the controls for answering calls, dialling, and hanging up are provided by the AT command set interface. This mode would be used if the modem were being integrated into a handheld terminal that will support voice communications.

Digital Audio - Digital audio is provided by the Motorola Proprietary DSC interface. This is used when an external handset such as would be used in an automotive installation is used. In this case, the call controls are provided on the handset. DSC handsets that support this interface are manufactured by and available from Motorola. The AT command set can also be used to control calls. The DSC interface is a Motorola proprietary feature that requires licensing from Motorola. Please contact your Motorola representative for more information.

Configuration Set-up and Audio Routing in g18

4.1.1 Voice connectivity

The g18 is an OEM Data & Voice module.
The voice connectivity can be done in two main channels – Analog voice, Digital voice.
The Audio route for the different devices is descried in the following table:
1. HF Refer to External Speaker & Microphone connected.
2. DHFA refers to External Car kit.
Correct set-up is in bold letters.

Table 8– Voice connectivity

Configuration Setup	Audio Route to…
Off hook handset (overrides all other conditions)	Handset.
On hook handset, or absence of handset: – HF + HF was selected by ATS96 command – HF + HF was not selected by ATS96 command – DHFA – Headset + HF was selected by ATS96 command – Headset + HF was not selected by AT command	 – HF external Speaker with Echo cancelling – HF External Speaker, W/O Echo cancelling – DHFA Speaker – Headset with Echo Cancelling – Headset W/O Echo Cancelling

Table 9 – Regular (HS) and HF mode using RS232

Characteristics	Regular Mode (Handset)	HF mode
Echo Cancelling (EC)	- Disable	+ Enable
Sidetone	+	- Mute
Echo Suppression (ES)	+ Enable	- Disable
	Full Duplex	Half Duplex

- Side-tone - When side-tones are enabled, an attenuated (reduced) version of the microphone audio input is routed to the selected speaker. This is so that the people speaking will hear themselves talking. This also creates a slight echo because the speaker sound then gets picked up again by the mic and again output to the speaker, etc. Echo suppress is designed to take care of this echo.
- Echo Suppress - Cancel a little of the output sound picked up by the input device (suppress the echo). It is designed to be used where there will be little to no echo (e.g. in a handset) rather that where there will be much echo (e.g. in a hands-free device).
- Echo Cancel - Suppress a lot of the output sound picked up by the input device (cancel all echo).
- Noise Suppress - An audio control that improves audio quality in all modes.

If the application is using DSC bus the HF selection can be done via new IP.

Table 10 - Regular (HS) and HF mode using DSC bus

Characteristics	Regular Mode (Handset)	HF mode
Echo Cancelling (EC)	- Disable	+ Enable
Side-tone	+	- Mute
Echo Suppression (ES)	+ Enable	- Disable
DSC Mic	- Mute	+

To activate the hands free mode, see the following table:

Table 11 – HF mode selection using AT command

Command	Description	Notes
ATS96 = 1	Hands free mode ON	+ Enable
ATS96 = 0	Hands free mode OFF	- Mute
Default	Hands free mode OFF	After setting the HF, it is kept in the flex even after power cycling the g18.

4.1.2 Data Communications

There are two modes to use the Data port:

- **GPRS -** This mode is for Package Data communication.
  This mode is starting from command mode and after an initialisation of a PDP context the data sent from the DTE will be over PPP.
  An available tool to do the PDP connectivity is a GPRS wizard (for PC applications).
  This is a very effective tool to transfer data in a high rate and only when data is available without any need to dial again.

- **CSD - Circuit Switch Data -** RS232 full flow control- this is the default setting for the g18. In this mode, we can transfer data and SMS and Fax class 1 using a full flow control (HW flow control), Xon/Xoff or non-flow control.
  The main difference from the GPRS is the need to dial to the desired number any time that data need to be transferred.

  Note: g18 does not support CSD non transparent with speed less than 4800

Table 12 – The supported features by using CSD / GPRS

CSD	Supporting
Flow Control	Flow Control: HW Xon/Xoff None
Data type	Transparent/Non transparent
SMS	SMS PDU mode. SMS Block Mode.
Fax	Class 1

GPRS	Supporting
Flow Control	Flow Control: HW Xon/Xoff None
Data type	Data over PPP
Multi slot	Class 1,2 &4, Support 1 uplink and 1,2 or 3 downlinks
Coding schemes	CS1, CS2, CS3, CS4

4.1.3 SMS Communications

Block Mode — This is a binary SMS presentation. There is a need of application SMS build for this mode.
Text Mode — This mode is not supported by the g18.
PDU Mode — This is the recommended mode for SMS communications. Note that the PDU packet has a complex structure, so careful examination of GSM 04.11 and GSM 03.40 is required.

4.1.4 FAX Communications

Class 1 — This is the basic set of FAX commands that is supported by all types of fax machines. To support fax with g18 used WinFax in your PC.
Class 2 — This mode is not supported by g18.

Basic Operations

4.1.5 Making a voice call

AT+CPIN=”nnnn”	Enter PIN number which enables the SIM Card. (4-8 digits)
ATDnnnnnn; OR AT*Dnnnnn OR ATD><index>; OR ATD>”name” OR ATDS=n; (n=0 to 3) OR	Initiates the voice call to the remote phone Commence voice communications The phonebook storage should be selected first at+cpbs=”sm” Phone number corresponding to the name entered Phone number from register #1 after setting at&z1=035658452 Phone number from register #0 after setting at&z1=035658452;

ATDS=n (n=0 to 3) OR ATD><mem><index>;	Phone number from SIM card #101 for example ATD>SM101
ATH	Hangs up on voice call Note: In Multi-party call, ATH does not end the last call, only AT+CHLD=1 does.

4.1.6 Receiving a voice call

AT+CPIN="nnnn"	Enter PIN number that enables the SIM Card (4 -8 digits)
AT+CRC=1	Enable cellular result codes extended format. Remote phone dials g18 voice number
+CRING:VOICE or +RING	If AT+CRC=1 , VOICE indicates an incoming voice call. if AT+CRC=0 then +RING will indicate incoming call. **Note:** To get the type of the call use CMER command.
ATA	Answer call

4.1.7 Commence voice communications

ATH or AT+CHUP	Hang-up call ends Note: In Multi-party call, ATH does not end the last call, only AT+CHLD=1 does.
Behaviour if remote phone hangs up first: The modem will stay online, (AT+CPAS returns +CPAS:004) for approximately 60 seconds, at which point it will time out and the call will be cleared (AT+CPAS returns +CPAS: 000). At any time during this period, the modem can execute an ATH.	

4.1.8 Making a CSD - data call

ATDnnnnnnn	Dial remote modem
CONNECT xxxx	Indicates connection made Proceed with data communications
+++	Escape to command mode
ATO	Return to online mode
+++	Escape to command mode
ATH or AT+CHUP	Hang up connection

4.1.9 Receiving a data call

Remote modem dials g18 data number.	
AT+CRC=1	Enable cellular result codes extended format. Remote phone dials g18 voice number
+CRING: REL ASYNC or +RING	If AT+CRC=1 , DATA indicates an incoming data call. if AT+CRC=0 then +RING will indicate incoming call. **Note:** To get the type of the call use CMER command.
ATA	Answer manually; ATS0=1 will enable automatic answer after 1 ring
+++	Escape from online mode
ATH or AT+CHUP	Hang up call. Note: In Multi-party call, ATH does not end the last call, only AT+CHLD=1 does.
Behaviour if remote phone hangs up first: The modem will stay online (+CPAS:004) for approximately 60 seconds, at which point it will time out and the call will be cleared (+CPAS: 000). At any time during this period, the modem can execute an ATH.	

4.1.10 How to Enable receiving of Cell Broadcast (CB)

Send AT+CKPD=”M>>S>>>>>S<SCC”

For receiving the CB message on the TE you should use the AT+CNMI command, for example:

AT+CNMI=0,2,2,0,0

4.1.11 g18 set-up in CSD mode

g18 set to work in CSD Mode

When a data call is received the RI signal goes active low for one second and then inactive high for four seconds repeatedly.

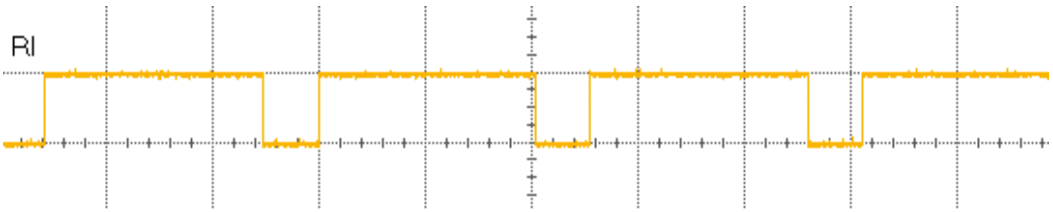


Figure 33 – RI waveform

After a data carrier has been detected by the g18, he sets the DCD signal active low.

Note: g18 does not support CSD non transparent with speed less than 4800

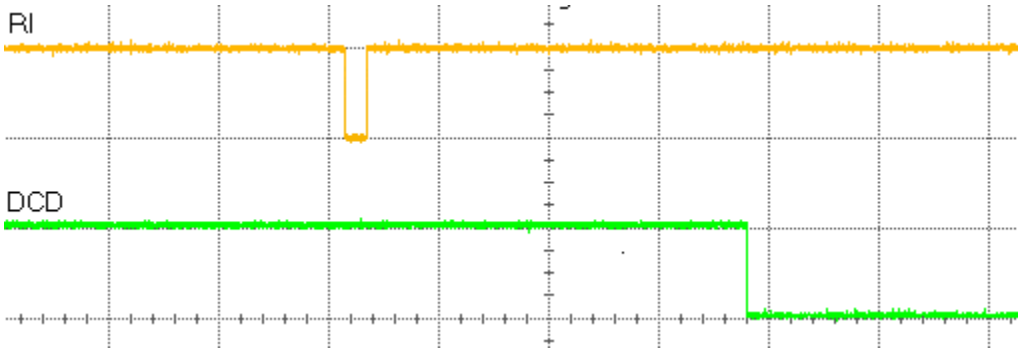


Figure 34 – g18 Receiving a data call

Sending and Receiving data in different flow controls

4.1.12 Flow control set to hardware Flow Control (FC)

4.1.12.1. Sending Data

When data is being sent by the g18, the only dynamic signals through the data transfer are TXD and CTS. The DTE device should keep DTR ON.

TXD is used in order to transmit the data from the terminal to the g18, and CTS is used in order to control the data flow. When data is being transferred too rapidly to the modem, in a rate greater then its transfer rate, and its buffers become full, the modem sets CTS inactive high, until he accomplishes the transfer.

When the modem is ready to accept more data, it sets the CTS signal active low again.

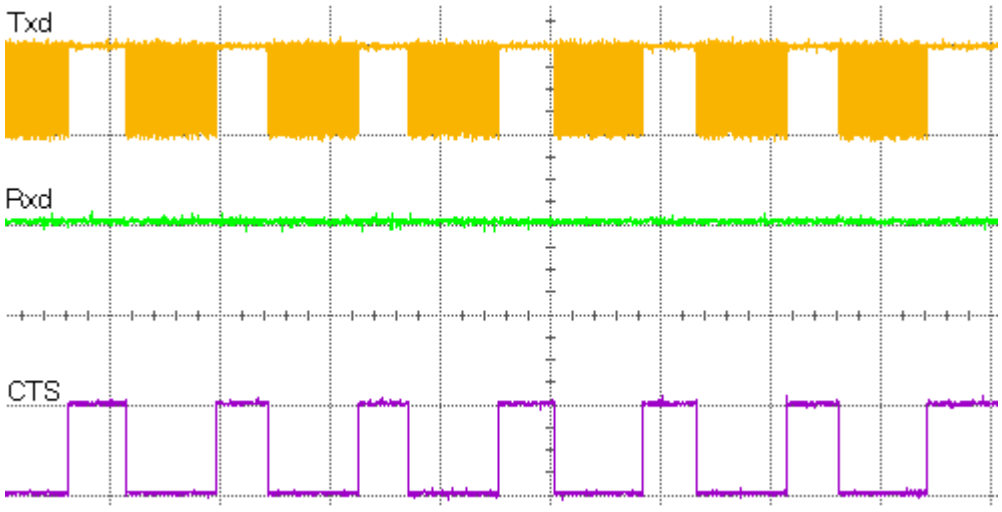


Figure 35 – g18 sending data HW flow control

4.1.12.2. Receiving Data

When data is being received by the g18, the only dynamic signal during the data transfer is RXD, on which the data is being sent to the terminal. The DTE device should keep DTR ON and RTS can be used to alert the G18 that DTE buffer is full.

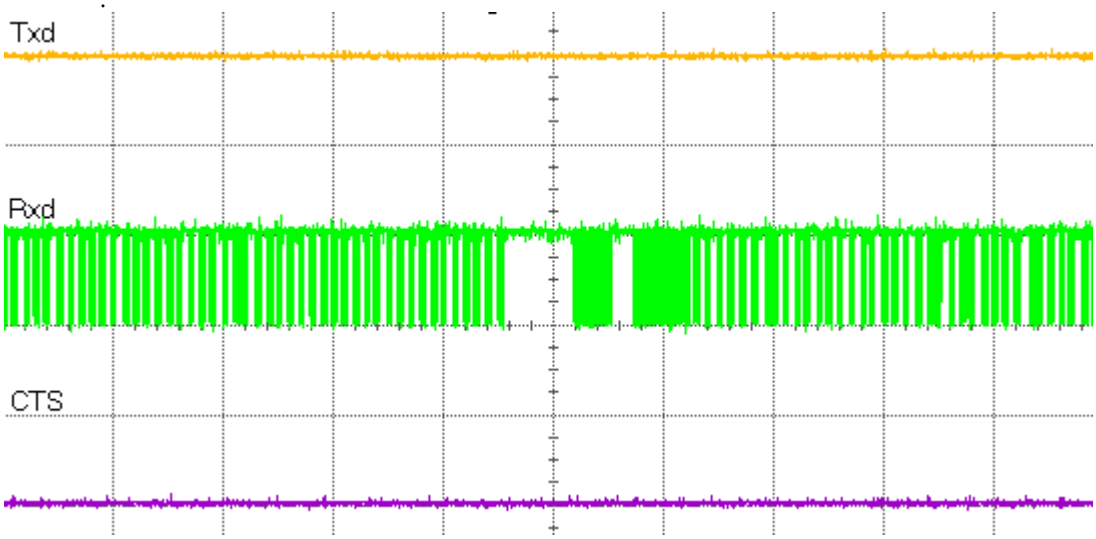


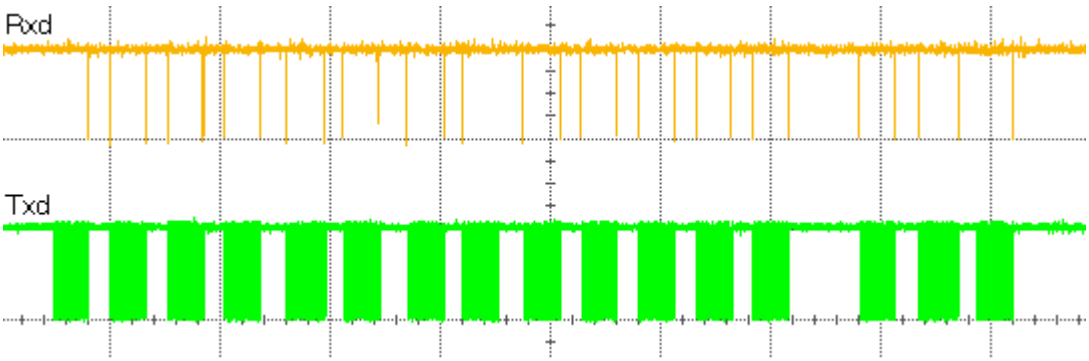
Figure 36– g18 receiving data HW flow control

4.1.13 Flow Control - Flow Control set to - Xon/Xoff

First, the g18 should be configured to Xon / Xoff flow control, by:
AT&K4
To return to HW flow control use - AT&K3

4.1.13.1. Sending Data

When a data is being sent in Xon/Xoff flow control, the data is transferred on the TXD line. The DTE device should keep DTR ON.



When the modem receives data in a high rate, its buffers may get full, and the transmission cannot be done in this rate. Then, it sends a Xoff signal to the terminal on the RXD line.
When the modem sends the data in the buffer and its ready to receive more data, it sends the Xon signal on the RXD line.

Figure 37 – Sending data Xon/Xoff

4.1.13.2. Receiving Data

When data is being received in Xon/Xoff flow control, the data is being transferred from the g18 to the terminal on the RXD line. The DTE device should keep DTR ON.

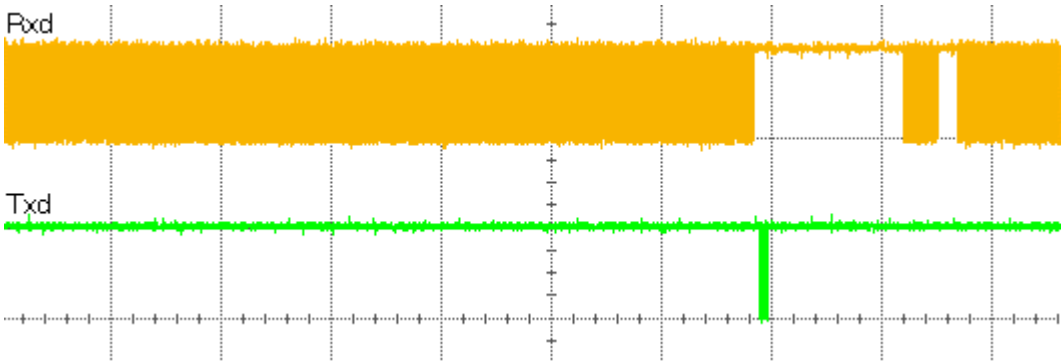


Figure 38 – g18 receiving data Xon/Xoff

NOTE: In the picture above, the Zmodem transfer protocol was used, with crash recovery setup. When an error is encountered, the terminal sends acknowledge to the sending side, asking it to send that block again.

4.1.14 Flow control set to 'None'

First, the g18 should be configured to Xon / Xoff by:
AT&K0
To return to HW flow control use - AT&K3

4.1.14.1. Sending Data

When data is being sent in this mode, it is sent on the TXD line, and there is no flow control. The DTE device should keep DTR ON.
When the modem cannot keep up with the transmission of data from the terminal, an error happens.

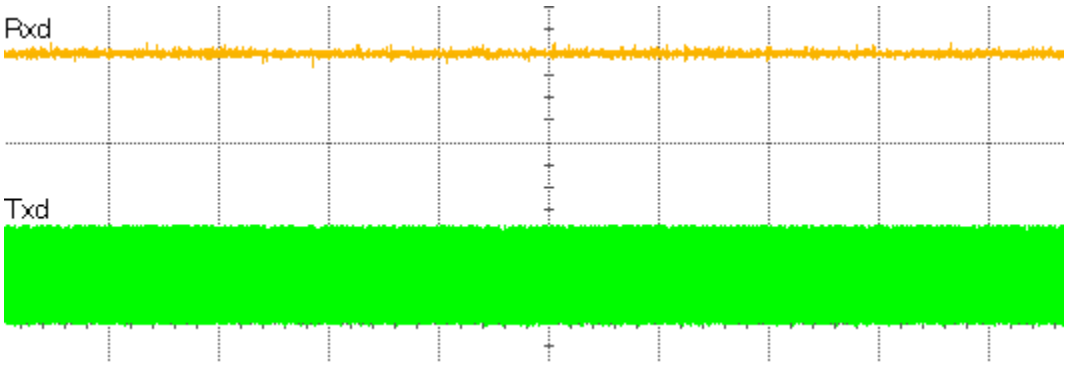


Figure 39–g18 sending data in 'none' FC

4.1.14.2. Receiving Data

Data is being received on the RXD line, which is the only dynamic line, in this receiving mode. The DTE device should keep DTR ON.

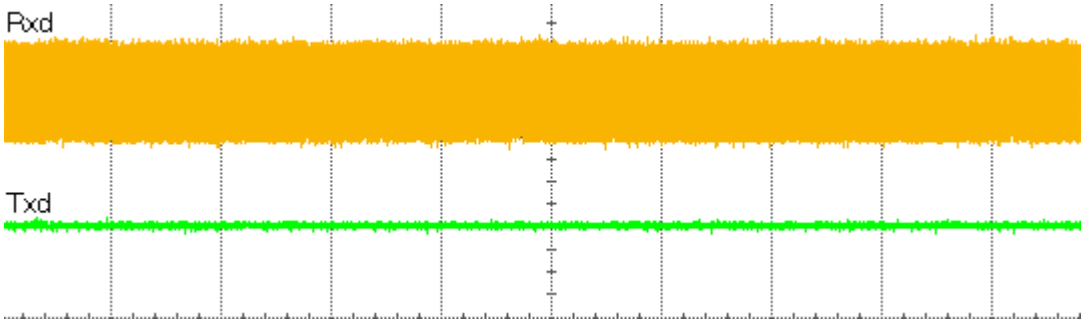


Figure 40 – g18 receiving data in 'none' FC

Call waiting, call forwarding, and conference calls

Note: These operations are network dependent. Some networks do not support these operations. Some behave unexpectedly, such as roaming or call dropout.

Sending SMS

4.1.15 Sending a SMS Message in PDU Mode

AT+CPIN=”nnnn”	Enter PIN, which enables SIM card. (4 - 8 digits)
AT+CSMS=0	Select message service response; response will be +CSMS:001,001,001
AT+CPMS=”SM”	Select preferred message storage; response will be similar to +CPMS:001,0015,001,015 depending on your SIM card.
AT+CMGS=<length of TPDU><cr>	
<SCA><TPDU><ctrl-Z>	<SCA>: Service Center Address, refer to GSM 04.11 <TPDU>: Transport Protocol Data Unit, refer to GSM 03.40

Example:
AT+CMGS=19
>07914483056100F511000B914410927856F40000000541E1905804<0x1A>
Will return +CMGS:000 after sending “ABCDE” to phone number 44-012-987-654 via the SMS center at 44-385-016-005. Note this is an example only; this particular SMS center is an UK number.

The following ASCII string is the ASCII representation of the hexadecimal values that will be transmitted as a binary string. So, ‘F’’4’ below means that the hex values 0xF and 0x4 will be transmitted over the air. CMGS=19 is the length of the TPDU in octets, see below. Note that the message is terminated with a Control-Z character (0x1A)
AT+CMGS=19
>07914483056100F511000B914410927856F40000000541E190F804<CTRL-Z>
07 = LENGTH OF SCA element including the TON/NPI

91 = TON/NPI,TON=9=Type of number, NPI=1=Numbering Plan Identifier

4483056100F5 SCA =SERVICE CENTER ADDRESS

I.E. the real phone number for the SCA is 44-385-016-005

- *Explanation of coding of phone numbers*. One hex digit for each phone number digit will be used. Each pair of hex digits is considered an octet (8 bit binary number). Then the two hex digits are reversed in order to form a semi-octet. So, The phone digits 3,8 will become 0x3, 0x8, then 0x38, and then reversed to become 0x83. The ASCII characters ‘8’ and ‘3’, ie the string ‘83’ are then inserted into the full ASCII string above. Since there are an odd number of digits, the last digit 5, is placed in the lower nibble of the last octet and then it top nibble is filled with 1’s. So ‘5’ becomes 0x5, then 0x05, then 0xf5, and then ‘f5’, the last two characters in the Service Center address.

Refer to ETSI 04.11 for more detail.

Looking at the rest of the message after the SCA we find the Transport Protocol Data Unit (TPDU), which contains the destination device address (phone number), and the user data or message. There are 38 characters, which represent 19 octets, which is the length of the TPDU.

11000B914410927856F40000000541E190F804 = TPDU
11 = 8 bits MTI,RD,VPF,SRR,UDHI,RP,MMS,SRI
00 = MR Message Reference
0B914410927856F4 = DA Transport Destination Address.
0B = Number of digits (11) in phone number
91=TON/NPI (as above)
4410927856F4 = Destination phone number 44-012-987-654.

Note that the destination phone number is converted to an ASCII string in the same manner as the SCA.

- **After the phone number is the user data control information and the user data.**
  0000000541e190f804
  00 = PID Protocol ID
  00 = DCS Data Coding Scheme
  00 = VP Validity Period
  05 = UDL User Data Length
  41E190F804 = The user data 'ABCDE'.

The user data is encoded as a GSM characters.

- *Description of encoding the user data.* The GSM character set is a method of encoding 7 bit ASCII characters into 8 bit numbers. GSM only supports 128 characters with ASCII values 0x00 to 0x7f. Since these only need 7 bits to define them, and the SMS message is transmitted as a series of 8-bit values, GSM uses a method of packing the series of 7 bit values into 8 bit octets. To explain:

ABCDE is encoded as 41E190F804 as follows.

A B C D E

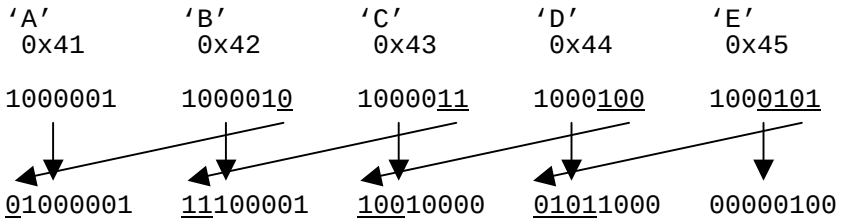
In ASCII hexadecimal is:

0x41 0x42 0x43 0x44 0x45

In 8 bit binary is:

01000001 01000010 01000011 01000100 01000101

We truncate off the most significant bit, resulting in a series of seven bit values. The process is to pack the now unused most significant bit(s) with enough least significant bits from the following value to fill it up to eight bits.



This results in the string of eight-bit hexadecimal numbers 0x41, 0xE1, 0x90, 0x58, 0x04. By continuing this process a string of 160 ASCII characters can be stored as a string of 140 bytes (octets).
The Service Center Address is described in ETSI GSM 04.11.
The Transport Protocol Data Unit is described in ETS GSM 03.40.

Note:

Sending and Receiving SMS messages interfere with each other, when the time in between is too short, or when both operations are taking place at the same time.

4.1.16 Sending SMS in PDU Mode - Wave Forms

4.1.16.1. Sending SMS in CSD mode

When sending SMS in PDU mode, after executing the at+cmgs=n command, the DCD line goes active low, and the data is transferred on the TXD line.
After executing the <Ctrl+Z> command, the DCD line goes inactive high again, and the message is being sent by the phone.

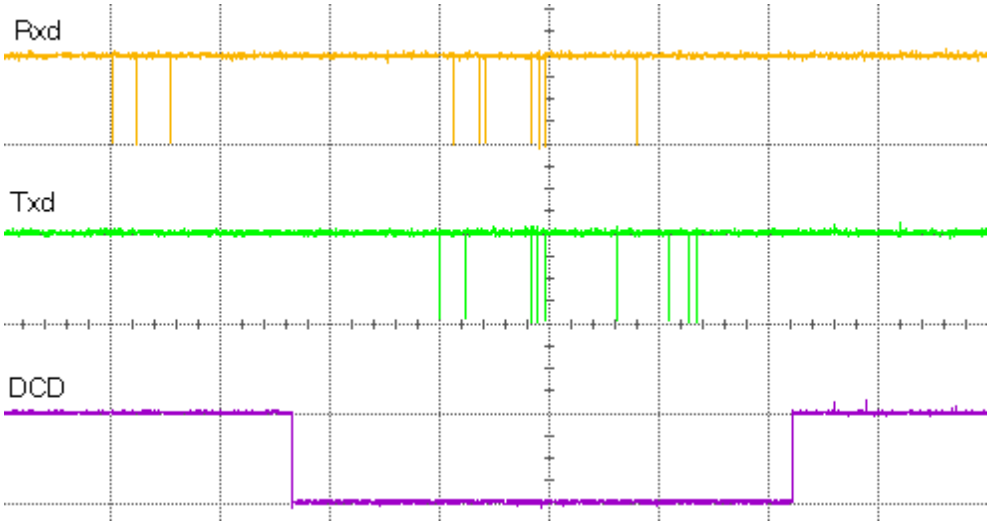


Figure 41 – Sending SMS

4.1.16.2. Receiving a SMS message

AT+CPIN="nnnn"	Enter PIN which enables SIM card. (4 -8 digits)
AT+CSMS=0	Select message service
AT+CPMS="SM"	Select preferred message storage
AT+CNMI=0,1	Allow buffer unsolicited result codes in the TA and indication of memory location is routed to TE
+CMTI: "SM",001	will be displayed (001 message location)
To display incoming messages:	
AT+CMGL=4	Lists all stored messages
AT+CMGR=1	Reads message at location 001
	+CMGR: 000,,102 0380214304028021000069905021000000064D2279258049940D321F21A946A4153F45B4E0735CBF379F85C064DCB727B7A5C0651CB73BA0B44459741D17A7ABC0609E5EFBB1B647CE341CA7A1B3E073DED6539888A2E8398617D1E447C9F5DA0986C46ABD96EB81C4C01 OK

Once the message has been received, the next step is to decode it into something readable. This particular message is generated by a Rohde and Schwarz CMD55 GSM Test station. Looking at the first line of data we see the information about the service center, followed by the TPDU.

0380214304028021000069905021000000064D2279258049940D321F21A946A4
03 = Length of service center address
80 = Type of number = unknown, number plan identifier = unknown
2143 = Service center address = 1234
04 = MTI = SMS-DELIVER, MMS = no more messages,
SRI = no status report UDHI = no UD header, RP =

reply path not set

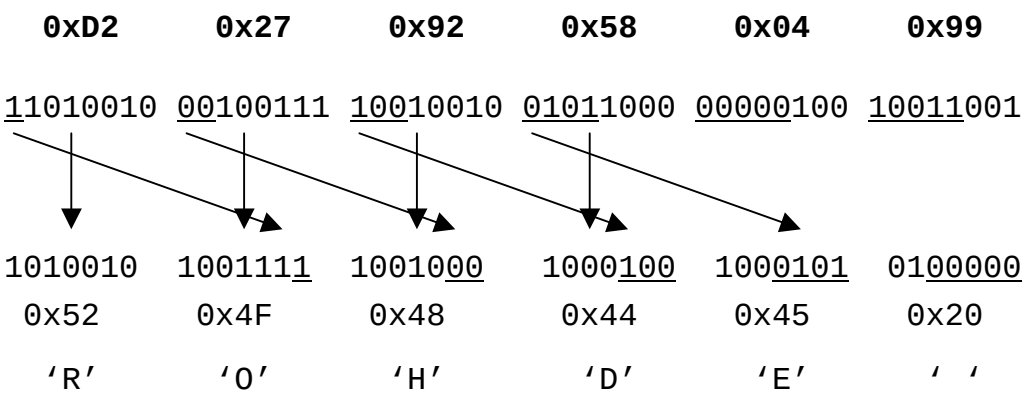
02 = OA length
80 =TON = unknown, NPI = unknown
21 = OA = 12
00 = PID =Protocol ID
00 = DCS = Data Coding Scheme
69905021000000=SCTS Service Center Time Stamp
= 5th Sept. 1996 12:00:00 GMT
64=UDL=User Data Length=100 octets

Now looking at the user data.

D2279258049940D321F21A946A4153F45B4E0735CBF379F85C064DCB727B7A5C0651CB73
BA0B44459741D17A7ABC0609E5EFBB1B647CE341CA7A1B3E073DED6539888A2E839861
7D1E447C9F5DA0986C46ABD96EB81C4C01

This is a string of GSM characters, and must translate back to ASCII. The process is the reverse of the coding process described above. This converts them back from a series of octets to a series of 7 bit ASCII numbers.
Looking at the first 6 octets:

D2 27 92 58 04 99



This decoding process continues for the entire user data string. Translating the entire string comes up with ROHDE & SCHWARZ THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG.

4.1.16.3. Sending and receiving binary data via SMS

Your specific application may require sending binary data, instead of an ASCII text message. In this case, you could simply insert your raw data as the user data, instead of using the GSM character coding process. This will limit you to 140 octets of data. As long as your application controls the encoding and decoding of the SMS PDU's at either end of the solution, you can use the 140 octets of user data as you see fit.

4.1.16.4. Receiving SMS in CSD mode - Wave Forms

When receiving SMS the message is stored on the SIM card.
The following picture shows a reading command being sent on the TXD line, and the message transferred from the SIM card to the terminal.

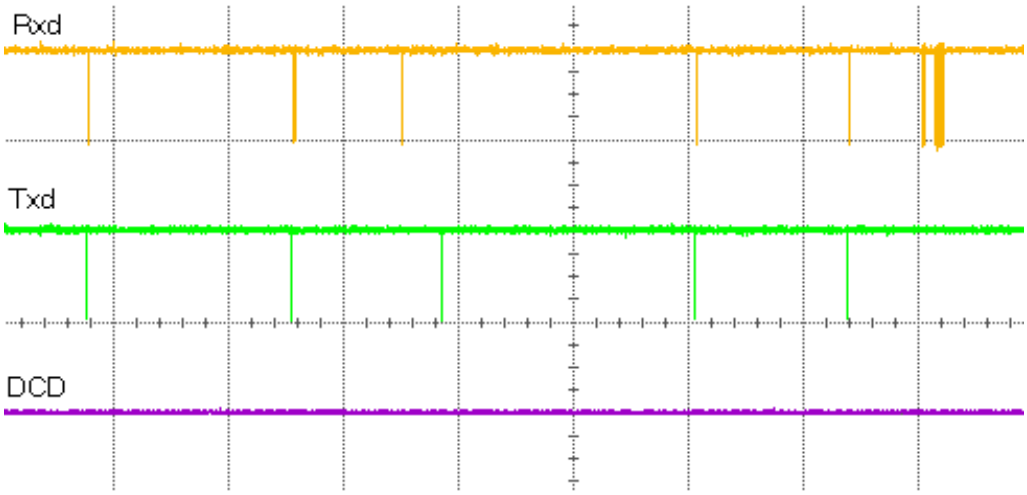


Figure 42 – Receiving SMS

4.1.17 Sending a Fax

4.1.17.1. Installing modem driver:

```
Control Panel-> Modems-> add modem-> next-> (windows is finding "standard
modem" on one of COM ports)-> change-> have disk-> |enter path to modem's
driver (For example: D:\motorola\modem) end choose "L-series"|-> next-> finish
(maybe, restart will be needed for use this modem)
```

4.1.17.2. Configuring modem in the WinFax:

```
1. Run WinFax.
2. Choose: Tools-> Program set-up-> Modems and Communications Devices->
   Properties...
```

3. Set "Motorola L Series" to Active (WinFax is beginning to test modem and result is "Failed" //`It is Ok for us`**//)**

```
4. Click next-> Choose "CLASS 1 (Hardware Flow Control)"->next-> Finish
set "Default" (or other)-> ok
5. In the "Modem and Communications Devices Properties" click "Properties.."->
6. In "General"->Communications port set Com port that modem is
```

`   connected to it  and initialize it at 57600 bps`

4.1.18 How to Establish GPRS PDP Context

For using the GPRS Network for HTTP/FTP browsing, you must be "attached" to the GPRS Network before the activation of PDP context.

Attachment may be done by 2 ways:

- Automatically after power up of your MS. On the screen you should see "GPRS" logo (With LEAP phone we saw it).
- Using the AT+CGATT=1 command
  You can check your attachment status by using the AT+CGATT? Command.

AT+CGDCONT=1,"IP","RTY","123.32.45.9

There are 3 main ways to activate PDP context.

1) If we use GPRS Wizard application, after "DOUBLE CLICK" on the button predefined as dialler for this provider, PDP context will be done automatically.
If the g18 was not attached to GPRS before, it will be attached automatically.

Configuration of the set-up

Enter into the wizard parameters received from your operator.
Set definitions to allow your http\ftp browser to use G18 as port to web.

usage

1. Open the GPRS wizard
2. Double click on the dialler icon to select and activate the provider you choose (you can have more then one provider in your list)
3. On the handset you will see after end of dialling your temporary IP address and then the "GPRS DATA Session" message.
4. You can minimized your GPRS wizard window and use your http\ftp browser (Internet explorer, netscape …)

2) If we use AT commands to activate PDP context, you must do the following steps:

- Define PDP contact (profile) for example: AT+CGDCONT=1,"IP","RTY",""
- Define Quality of service. for example: At+CGQREQ=3,2,4,5,8,12
- Define minimum acceptable Quality of service. For example: At+CGQMIN=1,0,,0,0,0
- Activation of PDP context via AT+CGACT=1 command.

Note: Keep in mind, that the AT command AT+CGACT is not supported in all countries with GPRS. Please add that a GPRS connection is also allowed or possible with ATD*99#. See also description below.

Configuration and set-up:

```
AT+CGQMIN=1,0,0,0,0,0
AT+CGQREQ=1,0,0,0,0,0
AT+CGCONT=1,"IP","APN","0.0.0.0",0,0   // "APN" – replace it with the provider
                                       //  name
AT
AT &F0 &D2 &C1 E0
AT V1 W1 S95=47
AT&K3
ATD*99#
```

The above list is only for the AT commands level. PPP information (DNSs,) is not shown here

3) Using ATD* command set:

- For selecting the provider, protocol and the profile use: ATD*99*(APN)*(protocol)*(CID)#
  Actually providers use : ATD*99# command to connect for their GPRS service.

Notes: In reference to buffering of DTE message data in the g18 (both inbound and outbound data):

1. Turning off the g18 will clear any buffered data.
2. Removing power from the g18 will clear any buffered data.
3. Every time the DTE drops PPP connection with the g18, via LCP terminate, that buffered data is cleared.
4. Every time the g18 drops PPP connection with the DTE, with LCP terminate, that buffered data is cleared. LCP termination is triggered the termination of the data in the g18 buffer.
5. Every time the g18 drops PPP connection with the DTE, without an LCP terminate, that buffered data is cleared. When dropping DTR it will also clear the buffer.
6. When the network send deactivation message or detach message it will clear the g18 buffer.
7. When g18 is transferring data in the uplink and the GPRS coverage is lost, the data may flowed-off. If the mobile has lost coverage and is unable to send the packet from the DTE to the network, the buffers will continue to store the packets until the buffers are full. The DTE will then be flowed OFF and the packets will be stored until they can be sent to the GPRS network.
   The amount of time that it will take before the user will notified is specified in T3312 timer that is resident in the mobile side. The default delay time of T3312 is 54 minutes, per GSM 0408 Spec. After 54 minutes the g18 will deactivate the PDP session.

4.1.19 How to change PIN code number

1. Check your CPIN status. If AT+CPIN? Returns +CPIN: READY then go next step, else if AT+CPIN? Returns +CPIN: SIM PIN then enter PIN number and check again that now the status is READY.
2. Check that AT+CLCK=”SC”,2 returns +CLCK: 1,7. If not then send AT+CLCK=”SC”,1,”Your PIN#” command.
3. Now you can change the PIN number by using the +CPIN command as follow: AT+CPIN=”Old PIN#”,”New PIN#”

4.1.20 How to write into the Fix Dialling (FD) phone book

Send AT+CLCK="FD",2 (Query Status)
If the response is: +CLCK: 1,7 - Enter AT+CLCK="FD",0,"PIN2".
After OK write operations in FD area will be allowed.

If the response is: +CLCK: 0,7 - Enter AT+CLCK="FD",1,"PIN2",
and after OK, enter AT+CLCK="FD",0,"PIN2".
After OK write operations in FD area will be allowed.

Basic AT Commands

Table 12 lists the basic AT commands for the g18 modem. Most of the basic commands are from V.25ter reference. Commands shown in bold are factory defaults.
The format of the command is:
AT<command>,
For example: ATE0 will turn off the echo command.
Note: To repeat command use the command A/ which will repeat the previous command. This is not prefixed with AT.

Table 13: basic including V.25ter call control commands

Command	Function
A	Go off-hook and attempt to answer a call
Dn	Dial modifier. For voice call use ATDxxx; or AT*Dxxxx or ATD>102; or ATD>"DAN" or ATDS=1; or ATDS=0 or ATD>SM101;
E0	Turn off command echo
E1	Turn on command echo
F	No action, compatibility only
H	Initiate a hang-up sequence
I0	Report product code
I1	Report pre-computed checksum
I2	Report processor name
I3	Report firmware revision
I4	Report product name
I6	Report processor name
L	No action, compatibility only
M	No action, compatibility only
N	No action, compatibility only.
P	No action, compatibility only
O	Go on-line
Q0	Allow result codes to DTE
Q1	Inhibit result codes to DTE
Sn=x	Set value x for S-register n.
Sn?	Return the value of S-Register n
S0	Read/Set number of rings before Automatic answer
S2	Read/Set Escape code character
S3	Read/Set Carriage return code character
S4	Line feed code character
S5	Command line editing character **Note:** command line editing, that except Backspace, Line feed and Carriage Return, all characters with hexa value 0 to $1F are ignored
S7	Wait time for data call carrier
S24	ATS24=0 – **g18** is not in sleep mode. ATS24=# **g18** is in sleep mode and will go to sleep mode after # seconds. See 3.1.3.
Sn for n equals to 14, 21, 22, 31, 36, 39, 40, 41	Bit map registers
S95	Bitmap register for extended result code

S96	Echo cancelling feature for audio devices by ATS96=1 . After sending this command, the radio should restart to activate it
S97	Antenna diagnostic feature: ATS97? Will respond with 000 or 001. 000 means either antenna not connected or HW not support this feature.
S98	ATS98=1 allows Handset's backlight to behave as if the unit was not powered by using the TS line. It will turn OFF the backlight immediately, for the 1st time after power up. Note: ATS98=x is allowed only for x=1.
S99	Ats99=x to defined length in ms of the hardware pulse given when GPRS coverage is changed from no coverage to coverage. the pulse length is 2x when data indication is sent. Default value is 30 ms. S99 responds with error if the value is greater than 2,147,483,647. Value of 0 is changed to 1, No error on that.
S100	ats100=x, x defines number of seconds. To avoid frequent hardware interrupts, the g18 use hardware indication for data only after x seconds from the last sent character to DTE. Default value of x is 1 second. S100 responds with error if value is grater than 32,767. Value of 0 is changed to 1, No error on that.
S101	will set wakeup line forever when x=1, and reset it when x=0. ats101? will return current state. These operations are allowed only when factory bit is set. When parameters are wrong, or factory bit is not set, return an error.
T	No action, compatibility only.
V0	Report short form (terse) result codes
V1	Report long form (verbose) result codes
W	Report DTE in Error Correction (EC) mode
X0	Report basic call progress result codes: OK, CONNECT, RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER, and ERROR
X1	Report basic call progress result codes and connections speeds: OK, CONNECT, RING, NO CARRIER (also for busy, if enabled, and dial tone not detected), NO ANSWER, CONNECT XXXX, and ERROR
X4	Report all call progress result codes and connection rate: OK, CONNECT, RING, NO CARRIER, NO ANSWER, CONNECT XXXX and ERROR
Y	No action, compatibility only
Z	Reset to default configuration
&C0	DCD is forced ON at all times
&C1	DCD is set to ON when CSD carrier is detected.
&C2	DCD is set to ON when PDP is active.
&D0	Interpret DTR on-to-off transition the modem ignores DTR.
&D1	Interpret DTR on-to-off transition the modem performs as Asynchronous to command mode.
&D2	Interpret DTR on-to-off transition The modem hangs up

&D3	Interpret DTR on-to-off transition the modem performs soft reset.
&F0	Restore factory configuration 0
&F1	Restore factory configuration 1
&G	No action, compatibility only.
&J	No action, compatibility only.
&K0	Disable all DTE/DCE flow control
&K3	Enable RTS/CTS DTE/DCE flow control
&K4	Enable XON/XOFF DTE/DCE flow control
&K6	Enable both RTS/CTS and XON/XOFF flow control
&L	No action, compatibility only.
&M	No action, compatibility only.
&P	No action, compatibility only.
&Q0	Select direct asynchronous mode (no effect in g18 as it has only Non Transparent mode)
&Q5	Modem negotiates an error corrected Link (Default) (no effect in g18 as it has only Non Transparent mode)
&Q6	Select asynchronous operation in normal mode (no effect in g18 as it has only Non Transparent mode)
&R	No action, compatibility only.
&S	Defines DSR's behaviour. (Actually always active).
&T	No action, compatibility only.
&V	Display current configuration and store profiles.
&W0	Store the active profile in NVRAM profile 0
&W1	Store the active profile in NVRAM profile 1
&Y0	Recall stored profile 0 upon power up
&Y1	Recall stored profile 1 upon power up
&Zn=x	Store dial string x (up to 35 characters) into location n= (0 to 3)
\N1	Select direct mode (no effect in g18 as it has only Non Transparent mode)
\N2	Select reliable link mode (no effect in g18 as it has only Non Transparent mode)
AT*A	Same as ATA
AT*D	dial voice call number
AT*P	No action, compatibility only.
AT*V	No action, compatibility only.
A/	Repeat last command
AT?	Return the value of the last updated S register.
AT$	List of supported AT commands

Table 16: Advanced AT commands list

Command	Function
+CRTT	Select Ring Tone
+CIPE	Enable/Disable CIP command
+CIP	AT command for sending IP primitives over RS232 (IP primitives are messages used by the DSC bus)
+CBAUD	Select the baud rate
+CGPRS	Indication of GPRS coverage.
+MTDTR	Supported for DTR line test command.
+MTCTS	Supported for CTS line test command.
+MCWAKE	Supported for DTE Wake line control command.
+MMGL	List of messages without changing their attribute
+MMGR	Read message without changing its attribute
+MMGA	Change message attribute
+CMSS	Send message from storage

Error Correction and Compression (ECC) Commands

The commands in Table 13 are supported by the g18 modem.

Table 17 – The commands that are supported by the g18

Command	Function
%C0	Disable data compression (no effect in g18 as it doesn't have compression)
%C1	Enable MNP 5 data compression. (no effect in g18 as it doesn't have compression)
%C2	Enable V.42 bis data compression (no effect in g18 as it doesn't have compression)
%C3	Enable both V.42 bis and MNP 5 compression (no effect in g18 as it doesn't have compression)
\A0	Set maximum block size in MNP to 64
\A1	Set maximum block size in MNP to 128
\A2	Set maximum block size in MNP to 192
\A3	Set maximum block size in MNP to 256
\G	Use of XON/XOFF flow control
\S	Show the status of the commands and S-Registers in effect

Fax Class 1 Commands

Table 18– FAX Class Commands

Command	Function	Remark
"FCLASS"	Select Mode	0 – data 1 – fax 2 -fax for manufacturer specific 8 - voice
"FAE"	fax_auto_answer	Class 1
"FRH"	fax_receive_hdlc_data	Class 1
"FRM"	fax_receive_data	Class 1
"FRS"	fax_receive_silence	Class 1
"FTH"	fax_transmit_hdlc_data	Class 1
"FTM"	fax_transmit_data	Class 1
"FTS"	fax_transmit_silence	Class 1

ETSI 07.07 Standard

The following tables are a listing of commands defined by ETSI standard 07.07 Phase 1 and supported by the g18 modem.
For more detailed descriptions of ETSI commands, please refer to ETSI document GSM 07.07 — prETS 300 916, GSM 07.05, GSM 03.40 Sections 9.1 and 9.2, GSM 04.11 Sections 8.2.5.1 and 8.2.5.2, and GSM 03.38.
For each command it is recommended that you use the ? option to query the modem for the particular details of each command. For example, use AT+CR? to get the full details on the +CR command.

Table 19 - General ETSI 07.07 Commands

Command	Description	Reference
+CGMI	Request manufacturer identification	5.1
+CGMM	Request model identification	5.2
+CGMR	Request revision identification	5.3
+CGSN	Request product serial number identification	5.4
+CSCS	Select TE character set	5.5
+CIMI	Request international mobile subscriber identity	5.6
+GCAP	Request overall capabilities of TA	V25ter sect 6.1.9

Table 20 - ETSI 07.07 Call control commands and methods

Command	Description	Reference
+CSTA	Select type of address, selects dial characters allowed in dial string	6.1
D	dial modes Dial modifiers for V.25ter dialling (TP!W,>IiGg)	6.2
Dx	V.25ter - Direct dialling from phonebooks where x is the location	6.3
+CMOD	Call mode	6.4
+CHUP	Hang-up call (similar to ATH)	6.5
+CBST	Select bearer service type (speed, V110/RLP, etc.)	6.7
+CRLP	Radio link protocol parameters	6.8
+CR	Service reporting control (result codes)	6.9
+CEER	Extended error report (report failure reason of last call)	6.10
+CRC	Cellular result codes	6.11
ITU-T V.25ter	Call control commands	6.20

Table 21 - ETSI 07.07 Mobile extended error report

Command	Description
+CEER	Extended error report
+CEER ERROR	1 Unassigned or unallocated number 3 No route to destination 6 Channel unacceptable 8 Operator determined barring 16 Normal call clearing 17 User busy 18 No user responding 19 User alerting, no answer 21 Call rejected 22 Number changed 26 Non selected user clearing 27 Destination out of order 28 Invalid number format (incomplete number) 29 Facility rejected 30 Response to STATUS ENQUIRY 31 Normal, unspecified 34 No circuit/channel available 38 Network out of order 41 Temporary failure 42 Switching equipment congestion 43 Access information discarded 44 Requested circuit/channel not available 47 resources unavailable, unspecified

	49 Quality of service unavailable 50 Requested facility not subscribed 55 Incoming calls barred within the CUG 57 Bearer capability not authorized 58 Bearer capability not presently available 63 Service or option not available, unspecified 65 Bearer service not implemented 69 Requested facility not implemented 70 Only restricted digital information bearer capability is available 79 Service or option not implemented, unspecified 81 Invalid transaction identifier value 87 User not member of CUG 88 Incompatible destination 91 Invalid transit network selection 95 Semantically incorrect message 96 Invalid mandatory information 97 Message type non-existent or not implemented 98 Message type not compatible with protocol state 99 Information element non-existent or not implemented 100 Conditional IE error 101 Message not compatible with protocol state 102 Recovery on timer expiry 111 Protocol error, unspecified 127 Inter-working, unspecified

Table 22 - ETSI 07.07 Network service related commands

Command	Description	Reference
+CNUM	Subscriber number	7.1
+CREG	Network registration	7.2
+COPS	GSM Network Operator selection	7.3
+CLCK	Facility lock	7.4
+CPWD	Change password	7.5
+CLIP	Calling line identification presentation	7.6
+CLIR	Calling line identification restriction	7.7
+CCFC	Call forwarding number and conditions	7.10
+CCWA	Call waiting	7.11
+CHLD	Call related supplementary services	7.12
+CTFR1 *	Reject an incoming call, and divert it to the voice mail (not to another number)	7.13
+CAOC	Advice of charge	7.15
+CLCC	List Current Calls and Asynchronous answers	7.17
+CPOL	Preferred operator list	7.18

♦ This command is biased from the +CTFR Standards, as described in description

Table 23 - ETSI 07.07 Mobile equipment control and status commands

Command	Description	Reference
+	Phone activity status (off, on, online) **Return Code** **Meaning** +CPAS:000 Ready +CPAS:001 Unavailable +CPAS:002 Unknown +CPAS:003 Ringing +CPAS:004 Call in Process +CPAS:005 Asleep	8.1
+CPIN	Enter / Change PIN (4 - 8 digits)	8.3
+CSQ	Signal quality	8.5
+CMEC	Mobile equipment control mode (optional if keypad and display not supported)	8.6
+CKPD	Keypad control	8.7
+CDIS ♦	Display Control - upon sending AT+CMER=0,0,1 current text display report is received	8.8
+CIND ♦	Indicator Control - upon sending AT+CMER=0,0,0,1 current indicator report is received	8.9
+CMER	Mobile Equipment Event Reporting	8.10
+CPBS	Select phonebook memory storage (optional if phone book not supported)	8.11
+CPBR	Read phonebook entries	8.12
+CPBF	Find phonebook entries	8.13
+CPBW	Write phonebook entry	8.14
+CRSM	Restricted SIM access	8.18
+CMUT	Mute control – Use AT+CIP with IP_MUTE_REQ command for mute toggling	8.24

Table 24 - ETSI 07.07 Mobile equipment errors and status reports

Command	Description	Reference
+CMEE	Report Mobile Equipment error	9.1
+CME ERROR	0 phone failure 1 no connection to phone 2 phone-adaptor link reserved 3 operation not allowed 4 operation not supported	9.2

♦ This command does not exist. For getting +CDIS functionality, follow the description.

♦ This command does not exist. For getting +CIND functionality, follow the description.

This command does not exist. For getting +CMUT functionality, use +CIP AT command – follow the description.

	5 PH-SIM PIN required 6 PH-FSIM PIN required 7 PH-FSIM PUK required 10 SIM not inserted 11 SIM PIN required 12 SIM PUK required 13 SIM failure 14 SIM busy 15 SIM wrong 16 incorrect password 17 SIM PIN2 required 18 SIM PUK2 required 20 memory full 21 invalid index 22 not found 23 memory failure 24 text string too long 25 invalid characters in text string 26 dial string too long 27 invalid characters in dial string 30 no network service 31 network timeout 32 network not allowed - emergency calls only	

V.25ter Commands Applicable to GSM

The following are the V.25ter commands that can be used with GSM.

Table 25 -V.25ter Commands used with GSM

Command	Description	V.25ter Reference
&C	DCD (Received line signal detector) Behaviour	6.2.8
&D	DTR (Data terminal ready) Behaviour	6.2.9
&F	Set to Factory-defined Configuration	6.1.2
+GCAP	Request Complete Capabilities List	6.1.9
+CGMI	Request Manufacturer Identification	6.1.4
+CGMM	Request Model Identification	6.1.5
+CGMR	Request Revision Identification	6.1.6
+CGSN	Request Product Serial Number ID (IMEI)	6.1.7
A	Answer	6.3.5
D	Dial	6.3.1
E	Command Echo	6.2.4
H	Hook Control	6.3.6
I	Request Identification Information	6.1.3
O	Return to Online Data State	6.3.7
S0	Automatic Answer	6.3.8
S2	Read/Set Escape code character	

S3	Command Line Termination Character	6.2.1
S4	Response Formatting Character	6.2.2
S5	Command Line Editing Character	6.2.3
S7	Connection Completion Timeout	6.3.10
S24	Sleep mode	
Sn for n equals to 14, 21, 22, 31, 36, 39, 40, 41	Bit map registers Note: S14 is read only register. when trying to type it will return OK but value is not changed.	
S95	Bitmap register for extended result code	
S96	Echo cancelling feature for audio devices by ATS96=1 . After sending this command, the radio should restart to activate it	
S97	Antenna diagnostic feature: ATS97? Will respond with 000 or 001. 000 means either antenna not connected or HW not support this feature.	
S98	ATS98=1 allows Handset's backlight to behave as if the unit was not powered by using the TS line. It will turn OFF the backlight immediately, for the 1st time after power up. Note: ATS98=x is allowed only for x=1.	
S99	Ats99=x to defined length in ms of the hardware pulse given when GPRS coverage is changed from no coverage to coverage. the pulse length is 2x when data indication is sent. Default value is 30 ms. S99 responds with error if the value is greater than 2,147,483,647. Value of 0 is changed to 1, No error on that.	
S100	ats100=x, x defines number of seconds. To avoid frequent hardware interrupts, the g18 use hardware indication for data only after x seconds from the last sent character to DTE. Default value of x is 1 second. S100 responds with error if value is grater than 32,767. Value of 0 is changed to 1, No error on that.	
S101	will set wakeup line forever when x=1, and reset it when x=0. ats101? will return current state. These operations are allowed only when factory bit is set. When parameters are wrong, or factory bit is not set, return an error.	
V	DCE Response Format	6.2.6
X	Result Code Selection and Call Progress Monitoring Control	6.2.7
Z0	Restore stored profile 0	6.1.1
Z1	Restore stored profile 1	6.1.1

Table 26 - V.25ter Voice commands

Command	Description
*A	Voice Answer
*D	Voice Dial
ATD*99	Request GPRS service "D"
ATD*100	Manual acceptance of a network request.
; Dial modifier	Modifier for Voice Dial
A	Voice Answer
H	Voice Hang-up

ETSI 07.05 Standard (SMS)

The following tables are a complete listing of commands as described in ETSI standard 07.05. For each command it is recommended that you use the ? option to query the modem for the particular details of each command. For example, use AT+CR? to get the full details on the +CR command.
Block mode is a stand-alone mode that makes use of full text commands and responses to send and receive SMS messages. This is an older mode that is provided for compatibility reasons. It is recommended that PDU mode be used instead of block mode.
Text mode is not supported by the modem.
PDU modem is the preferred method as it is the simplest and easiest to use.

4.1.21 Block Mode

SMS Block Mode is described fully in GSM 07.05, section 2.

Table 27 - ETSI 0705 TE Commands sent from host to phone

Command	Description	ETSI 07.05 Reference
ACKNOWLEDGE MESSAGE	Acknowledge receipt of INC MESSAGE or MESSAGE ARRIVED	2.4.1.12
DELETE MESSAGE	Delete SMS message	2.4.1.9
END SMS MODE	Terminates SMS/CBS mode of the DTE/DCE interface	2.4.1.11
GET FIRST MESSAGE	Get first message stored on phone	2.4.1.3
GET MESSAGE	Get specific message stored on phone	2.4.1.2
GET NEXT MESSAGE	Get next message stored on phone	2.4.1.4
INDICATE INC SMS	Request notification of any incoming SMS messages	2.4.1.6
INSERT SMS	Send SMS message	2.4.1.8
LIST REQUEST	Request list of message stored on phone	2.4.1.1
TRANSFER INC CBS	Request direct transfer of broadcast messages directly to host computer	2.4.1.7
TRANSFER INC SMS	Request direct transfer of incoming SMS messages from the air directly to host computer	2.4.1.5
UNABLE TO PROCESS	Sent by the host to indicate that a phone message could not be processed	2.4.1.10

Table 28- ETSI07.05 MT Responses sent from phone to host

Response	Description	ETSI 07.05 Reference
DELETE MESSAGE COMPLETE	Host's request to delete a message has been completed	2.4.2.8
DELETE MESSAGE FAILURE	Host's request to delete a message has failed	2.4.2.9
END SMS MODE	Phone is exiting SMS mode	2.4.2.11
GET MESSAGE FAILURE	Sent when a request for a message cannot be fulfilled	2.4.2.3
INC MESSAGE	Sent if incoming message transfer to host has been requested	2.4.2.4
INSERT SMS COMPLETE	Host's request to insert a message has been completed	2.4.2.6
INSERT SMS FAILURE	Host's request to insert a message has failed	2.4.2.7
MESSAGE	Sent when a message has been requested	2.4.2.2
MESSAGE ARRIVED	Send if indication of incoming messages has been requested	2.4.2.5
MESSAGE LIST	Sent on receipt of LIST REQUEST	2.4.2.1
REQUEST CONFIRMED	Request received and will be performed	2.4.2.12
UNABLE TO PROCESS	Host's request could not be processed	2.4.2.10

4.1.22 Text Mode

Text Mode is fully described in GSM 07.05, section 3.
The g18 module does not support text mode, but these commands are supported, as they are useful for PDU mode.

Table 29- ETSI 07.05 Text Mode

Command	Description	ETSI 07.05 Reference
+CSMS	Select message service (phase 2, phase 2+, etc.)	3.2.1
+CPMS	Preferred message storage	3.2.2
+CMGF	Message format: PDU or text mode selection, PDU = default	3.2.3
+CESP	Enter SMS Block Mode Protocol	3.2.4
+CMS	**Message Service Failure Result Code :** 0...127 GSM 04.11 Annex E-2 values 128...255 GSM 03.40 sub-clause 9.2.3.22 values 300 ME failure 301 SMS service of ME reserved 302 operation not allowed 303 operation not supported 304 invalid PDU mode parameter 305 invalid text mode parameter 310 SIM not inserted 311 SIM PIN required 312 PH-SIM PIN required 313 SIM failure 314 SIM busy	3.2.5

	315 SIM wrong 316 SIM PUK required 317 SIM PIN2 required 318 SIM PUK2 required 320 memory failure 321 invalid memory index 322 memory full 330 SMSC address unknown 331 no network service 332 network timeout 340 no +CNMA acknowledgement expected 500 unknown error	
+CMGD	Delete Message	3.5.4
+CSCA	Service Centre Address	3.3.1
+CNMI	New Message indication	3.4.1
+CMGL	List messages	3.4.2
+CMGR	Read message	3.4.3
+CNMA	New message acknowledgement to ME / TA	3.4.4
+CMSS	Send message from storage	3.5.2

4.1.23 PDU Mode

PDU mode is described fully in GSM 07.05 Section 4. PDU mode uses the same commands and responses as the Text Mode described above. PDU mode however uses different formats for the following commands and responses.
In addition, refer to GSM 04.11 and GSM 03.40 for details on formatting the Service Center Address and Transport Data Protocol Unit of the SMS PDU.

Table 30 - ETSI 0705 PDU Mode

Command	Description	ETSI 07.05 Reference
+CMGL	List messages	4.1
+CMGR	Read message	4.2
+CMGS	Send message	4.3
+CMGW	Write message	4.4
+CNMA	New Message Acknowledgement to ME/TA	4.6
+CMSS	Send message from storage	4.7

GPRS COMMANDS

Table 31 - ETSI 07.07 Commands for GPRS

Command	Function	Reference
+CGDCONT	define, modify or remove a PDP context	10.1.1
+CGQREQ	define, modify or remove a requested Quality of Service Profile	10.1.2
+CGQMIN	define, modify or remove a minimum required Quality of Service Profile	10.1.3
+CGATT	GPRS attach/detach request	10.1.4
+CGACT	PDP context activation/deactivation request	10.1.5
+CGPADDR	Show PDP address	10.1.8
+CGCLASS	interfacing Mobile Station class parameters (Store, manage, retrieve)	10.1.11

CHAPTER 5 Hardware

The following vendor and parts Information is provided as a recommended solution for acquiring host interface, modem antenna, and evaluation board components. You are also welcome to research and recommend your own solution for acquiring needed components.

5.1 Host Interface

5.1.1 Modem I/O Connector

For the modem-to-host interface, use the 36-pin ZIF-style serial connector. Use the following descriptions to order connectors from ELCO:

- Part number 04 6240 036 003 800

Motorola recommends that you use same connector for the host-to-modem interface connection.

5.1.2 Interface Cable

The serial interface cable is a 36-pin 0.5 mm pitch flexible printed circuit (FPC). Use the following descriptions to order interface cables from Parlex Corporation:
0.5MM-36-xx-B Mates with ELCO 6240 series connector
where xx indicates length in inches. “Mates with ELCO 6240 series connector” indicates that the FPC is to be connected to an ELCO connector.

Antennas

5.1.3 GSM Antenna

The style of the antenna is highly dependent on the particular requirements of the project.

Frequencies	GSM 900:	TX band	880-915MHz,	RX band	925-960MHz.
	DCS:	TX band	1710-1785MHz	RX band	1805-1880MHz.
	PCS:	TX band	1850-1910MHz,	RX band	1930-1990MHz.
Gain	0 dBi (Unity) gain or greater.				
Impedance	50 Ohm				
VSWR	typical 1.5:1				

5.1.4 GPS Antenna

Frequency	1575.42 MHz (L1)
Bandwidth	± 1.023 MHz
Polarisation	Right hand circular
Impedance	50 Ohm
Gain requirement	10 dB to 26 dB (at receiver input)
Gain Pattern	+0 dBic minimum at zenith
	-10 dBic minimum at 0 elevation
Noise figure	1.8 dB typical
	2.2 dB maximum
VSWR	1.5:1 typical
	2.5:1 maximum
Axial ratio	3 dB typical at zenith
	6 dB maximum at zenith
1 dB compression point	-14 dBm typical (at antenna output)
3 dB frequency bandwidth	45 MHz maximum
25 dB frequency rejection	± 95 MHz
Ground plane	15 x 15 cm recommended

Antenna Connector
The antenna connector on the g18 for GSM and GPS port is an 82MMCX-S50-0-3 (female). Mating connectors to the 82MMCX include the following two options only:
11MMCX Straight connector (male)
16MMCX Right angle connector (male)
Use the preceding descriptions to order antenna connectors from Huber-Suhner.

5.1.5 Antenna Cable Assembly

The antenna cable assembly as supplied in the developer kit uses a SMA (female) with an 8-inch RG316 cable to a male MMCX connector.
Following two options as orderable antenna cable assemblies from Huber-Suhner:
RG316/16MMCX/21SMA/.203M Straight jack
RG316/16MMCX/24SMA/.203M Bulkhead jack
An alternate supplier, Conectec, can also provide long 90 degree MMCX connector and RF cable assembles
Huber-Suhner and Conectec also provide assemblies with other connector types.

Developers Kit

Motorola part number S9002B
Includes (Motorola part numbers):

FTN8071B	Evaluation board
Antenna	85-09397T03
8102430Z04	Small SIM card
6887968L01	GSM Engine / Modem Integration and Application Developers Guide
3085717G04	Flex cable, 36 line ZIF
3085717G01	Flex cable, 30 line ZIF
3085720F01	Antenna adapter cable
0185602G03	miscellaneous hardware
SYN9048A	HUC
8509397T03	Tri band antenna
SCN5011A	Handset with SIM

Optional accessories

SCN5012A	Handset without SIM
SYN6962A	Headset
SYN4937A	Headset
SMN4097A	MIC
SNN4018A	Speaker
HFK9200A	DHFA accessory
39-03920K01	Antenna contact on EV board
8287427L03	GPRS wizard
FTN8105A	D15 EV board Retrofit kit for g18 support.

Dealer Contacts

Allgon Antenna AB

Box 500, SE-184
25 Akersberga, Sweden
Phone: +46 8 540 601 20
Fax: +46 8 540 676 16
Website: www.allgon.se
Email: info@allgon.se
Product: antennas

Conectec RF, Inc.

2155 Stonington Way, Suite 108
Hoffman Estates, IL 60195 U.S.A
Phone: (847) 519-0100
Fax: (847) 519-1515
Web site: none
Email: ctecrf@ix.netcom.com
Product: Antenna cable assemblies

ELCO ZIF connector

AVX Ltd
Admiral House
Harlington Way
Fleet, Hampshire
England GU13 8BB
Africa
Phone: +44-1252-770062
Fax: +44-1252-770104
Europe
Phone: +44-1252-770130
Fax: +44-1217-057145
Middle East
Phone: +44-1252-770062
Fax: +44-1252-770104

AVX/Kyocera (Singpore) Pte Ltd
39A Jalan Pemimpin
#07-00 TAL Building
Singapore 577183
Asia
Phone: 65-350-4892
Fax: 65-258-1756

AVX Corporation
801 17th Avenue South
Myrtle Beach, SC 29578-0867
North America
Phone: 843-946-0585
Fax: 843-626-5292
South America
Phone: 843-946-0392
Fax: 843-626-2396

Electro Mech, Inc.

2 Cordier StreetIrvington, NJ 07111U.S.A
Phone: (201) 318-7999
Fax: (201) 318-7995
Web site: none
Email: none
Product: power supplies
FRAMATOME CONNECTORS.
SIM connector supplier.

Galtronics LTD Antennas

P.O. Box 1569
Tiberias 14115
Israel
Web site: http://www.galtronics.com/
Phone: +972 6 673 9777
Fax: +972 6 673 3000
Product: antennas
Bogart, Georgia
Tel: +1 (706) 546-0087
Fax: +1 (706) 546-1298
San Diego, California
Tel: +1 (858) 451 3730

Fax: +1 (858) 451 3571
Chicago Area, Illinois
Tel: +1 (262) 942 7259
Fax: +1 (262) 942 7260
Tianjin, China
Tel: +86 (0)22-26517176/7
Fax: +86 (0) 22-26517178
Japan
Tel: +81 (0) 47-394-8227
Fax: +81 (0) 47-394-8244
Livingston, UK
Tel: +44 (0) 1506 460430
Fax: +44 (0) 1506 461007

Huber+Suhner

1014 East Algonquin Road
Suite 104Schaumburg, IL 60173
U.S.A.
Phone: (847) 397-2800
Fax: (847) 397-2882
Website: www.hubersuhnerinc.com
Email: sschweizer@hubersuhnerinc.com
bburress@hubersuhnerinc.com
Product: Antenna cables and connectors

Huber+Suhner GmbH

Hans-Peter Manser Hehlbeerenstrasse 6
D - 82024 Taufkirchen Germany
Phone: 0049-89-6-12-01-0
Fax: 0049-89-9-12-01-162
Product: Antenna cables and connectors

Huber+Suhner Hong Kong Ltd.

Suite 902, 9/F Jubilee Centre
18 Fenwick St.
Wanchai Hong Kong
Phone: +852 2866-6600
Fax: +852 2866-6313
Product: Antenna cables and connectors

Huber+Suhner (Singapore) Pte. Ltd.

1 Tuas Basin Close
Singapore 638803
Phone: +65 861 8186
Fax: +65 861 3316
Product: Antenna cables and connectors

Larsen Electronics

3611 N.E. 112th Ave.
Vancouver, WA 98682
U.S.A.
Phone: 1-800-778-7854, ext 711, 742
Fax: (360) 944-7556
Website: www.larsenet.com
Email: pstorm@larsenet.com
Product: antennas

Parlex Corporation

7 Industrial Way
Salem, NH 03079
U.S.A.

Phone: (603) 893-0040
Fax: (603) 894-5684
Website: www.parlex.com
Email: jholdeman@parlex.com

Product: Serial interface cables

Santac Connectors

North America:

MVP Sales
820 South Bartlett Road
Suite 108
Streamwood, IL 60107
U.S.A.

Phone: 630 483 8766
Fax: 630 483 1993
Email: mvpsales@msn.com

Africa:

ARROW ALTECH DISTRIBUTION LTD
53-57 YALDWYN ROAD
HUGHES EXT. JET PARK 1459
JOHANNESBURG POST OFFICE
JOHANNESBURG SOUTH AFRICA

Phone: +27 11923 9713
Fax: +27119749683
Email: djrodger@arrow.altech.co.za

Asia:

SAMTEC ASIA PACIFIC PTE LTD
1 KALLANG SECTOR #05-01
KOLAM AYER INDUSTRIAL PARK
REPUBLIC OF SINGAPORE,
SI 349276

Phone: +657455955
Fax: +658411502
Email: yvonne.tang@samtec.com

Europe:

SAMTEC EUROPE LTD
117 DEERDYKES VIEW
WESTFIELD INDUSTRIAL ESTATE
CUMBERNAULD, SCOTLAND
UK G68 9HN

Phone: +44 1236739292
Fax: +44 1236727113
E-mail: julie.campbell@samtec.com

Middle East:

DIMTEC ADIEL LTD
7 PROPES ST
PO BOX 7637
RAMAT GAN
IS 52176

Phone: +972 36781758
Fax: +972 36781738
E-mail: oferdim@zahav.net.il

CHAPTER 6 Testing

This section contains a product development checklist of parameters to check, requirements to meet, and standards of performance to evaluate. You can use these process checks and functional test procedures to fully qualify that the g18 Integrated Wireless Modem is well integrated with your host product.

Introduction

Proper testing throughout the development and integration cycle ensures that the final product works in both normal and exceptional situations. These tests are provided in several stages as follows:

1. Hardware integration
2. Desense and EMI
3. Regulatory compliance
4. Application software
5. Final assembly
6. End user problem resolution
7. OEM service depot repair

Testing Stages

6.1.1 Hardware Integration

To ensure that the integration effort is carried out properly, monitor all relevant engineering standards, requirements, and specifications. In addition, perform functional tests during product development to validate that the integrated package performs as designed.

6.1.2 Enabler Functions

To test the interaction between the modem and host, your product must be able to perform the following:

- Turn the various hardware components on and off. This capability helps to isolate possible desense and other emissions problems.
- Pass data through the host between the modem and the test platform. This allows external programming and configuration software to communicate with the modem while it is integrated within the host. For microprocessor-based products, pass-through mode uses software emulation involving the host processor, which passes full-duplex serial port data to and from the integrated modem.

6.1.3 Specific Tests

In addition to the various tests that exercise your own circuitry, such as power-on self test), design tests that ensure proper interaction between the modem and host. Ensure that the following hardware integration issues are evaluated

RF Immunity	RF transmissions of the modem do not interfere with operation of the host
Electrical Signaling	Power sources and interface are functionally compatible between the host and the modem.
Physical Parameters	Physical configuration of the modem inside the host provides adequate ventilation, mounting, shielding, and grounding.
Antenna Performance	Integrated antenna system meets the required ERP specifications, VSWR specifications, and antenna propagation patterns.
ESD Requirements	Host design protects the modem from ESD

RF Re-radiation	Host does not allow spurious emissions in excess of 60 dBc, as caused by carrier re-radiation.

6.1.4 Desense and EMI

Any host in which the modem is integrated generates some EMI (electromagnetic interference), which tends to desensitize the modem's ability to receive at certain frequencies. You should verify that there is no influence from the host equipment to the g18 performance. (See Desense testing in Annex G).

Motorola can direct you to a facility for testing the amount of desense that your modem experiences while in a host platform. Specifically, modem receiver sensitivity is recorded while operating with the host under test. For this test, you provide an integrated product, including antenna, power supply and any peripherals. Motorola then produces a test graph that reports the amount of desense. If a test fails, Motorola is available to perform additional tests at standard industry rates. All desense testing is performed at Motorola facilities.
To prepare for the desense test, provide Motorola with hardware to generate EMI that is representative of the final product, including the cables, power supplies, and other peripheral devices.

If desense was detected than a few actions can be done:

1. **Connect the antenna cable shield to the main ground (PS ground).**
2. **Shield the logic section in the user application. (most of the radiation can come from clocks and data lines around the logic section due to the high rise/fall time of the pulses).**
3. **A Ferrite can be wrapped around the antenna cable.**
   Recommended ferrite: Fair Rate (company mane) # 2643023002 or # 0431173951.

6.1.5 Regulatory Compliance

Most countries where the final product will be sold currently require approval from the local government regulatory body. In the US, the FCC requires that two individual requirements be met before the final product can be certified. The first test, the FCC Part 15 qualification, requires you to prove that the product electronics hardware does not yield local radiation capable of affecting other equipment, such as TVs, computer monitors, and so on.
The second test (FCC Part 24) requires you to prove when the modem transmits; it remains properly in its allocated channel spacing, and does not produce spikes or splatter in other frequencies. Motorola undergoes FCC testing with the modem integrated into a dummy OEM host to ensure compatibility with these requirements. But since the eventual transmit capability of the modem is highly integrated with the power supply and antenna system of the future host, the fully integrated product must be submitted for final regulatory approval.
In addition, regulatory bodies can require the wireless modem to transmit random data patterns on specific frequencies while incorporated in the host platform. The modem incorporates special debug modes to allow this kind of testing, provided the host application can issue the required commands to the modem.
The entire regulatory process can take many months to complete and should start early in the development cycle. The exact regulatory requirements of each country change from time to time. For efficient regulatory processing, use the services of specialized regulatory consultants to determine the specific requirements at the time of manufacture.
To prepare for regulatory testing, you need to integrate the pass-through mode into the product design (see "Enabler Functions" on page 78). Pass through mode passes the RS-232 levels from an external PC to and from the modem. Motorola provides the ability to key and dekey the radio at the required frequencies and modulation levels from an external PC via the pass-through mode.

Nothing else is needed for regulatory requirements for the g18, which is approved to part 24 when used in your host device. The product is approved by FCC and DOC. The host device still will require approval to part 15

For further information about regulatory compliance, refer to "Regulatory Requirements" on page 10.

6.1.6 Application Software

Tests need to verify the communications links between the host and the modem and between the modem and the network, as follows:

Software Driver Configuration
Ensure that the host product can enable the modem serial port to permit the host and modem to communicate. This test verifies that the driver software functions well and is configured properly.

Network Configuration
Determine if the host can use the modem to communicate with a GSM network. This test uses existing network software in an attempt to communicate with a specific network.

NOTE: Make sure the g18 is set to the correct band.

The final application must be able to respond correctly under all adverse network conditions, not just the ideal case. To achieve this, the application software has to be systematically tested against all possible failure and exception conditions. Situations such as low battery, out of range, host down, unexpected data, maximum message size, maximum peak/sustained throughput, and other conditions must not cause the host application to fail. Each condition must have a specific remedial action to alleviate it.

Final Assembly

A final assembly test is performed before shipment to ensure all components are working properly and issues such as crimped antenna cables, lose connections, and improper software load are resolved. During final assembly, the modem sends and receives a loopback message of maximum size. The successful return of the sent message proves the product can transmit and receive correctly.

6.1.7 End User Problem Resolution

When the final product is in the hands of the end user, testing must quickly isolate the cause of the problem in the field. For example, is the problem caused by the terminal, the modem, the network, the configuration, or a user error? Can the problem be fixed locally or does the unit need to be sent to the service shop?
It is very time consuming and expensive to send products to the service shop, especially if the problem is caused by a temporary network or host outage. For this reason, you should design the application to allow for end-user problem determination. Often this functionality can be designed co-operatively with the Help Desk, which supports the user
over the telephone and without access to the user's screen. The application must enable the end user to relate the most likely cause of the problem to the Help Desk for a quick solution.
Effective tests provide a systematic, positive acknowledgment from each of the network components. For example:

Test 1 Is the OEM module able to pass its own self test?
Test 2 Is the OEM module able to communicate with peripherals?
Test 3 Is the OEM module able to communicate with the integrated modem?
Test 4 Is the modem able to hear the network?
Test 5 Is the modem registered and allowed to operate on the network?
Test 6 Is the gateway (if present) up and running?
Test 7 Is the host up and running?

6.1.8 OEM Service Depot Repair

When a unit comes in to the OEM for service, the first requirement is to determine whether the modem must be sent on to Motorola for repair. A screening test must be performed, one that mounts the modem on the Motorola evaluation board and sends a loopback message to qualify the specific problem.
To set up for this test, you need to have an evaluation board, a known-good g18 modem (for comparison), and a power supply. The end-to-end test can employ either a live network or an over-the-air test involving a communications monitor that can transmit and receive at the appropriate frequencies. The objective is to test the suspect modem in a known-good environment, in which all other components are known to be operational.

6.1.9 Diagnostic Utility

This appendix describes how to develop a script to perform a factory end-of-line test of a g18 modem integrated in an OEM platform. This test provides a high degree of confidence that the modem is properly configured and integrated, and is ready for shipment.

CAUTION ! **OEM service operations are encouraged to modify the following QA test procedure to develop a test for the diagnostic screening of repair products.**

6.1.10 Quality Assurance Testing

Efficient, automated testing can ensure the product is functional when delivered to the end user, especially when OEM product manufacturing occurs in a region or country distant from the intended network. Use the following checklist to verify that a product is ready for shipment:

1. OEM host platform (without modem) is operational.
2. OEM host platform contains the correct software load.
3. OEM host platform provides sufficient power to operate the modem.
4. Modem is loaded with the correct software version.
5. Modem is loaded with correct frequencies.
6. Modem is configured for the correct ID and network registration information.
7. OEM host communicates with modem logic board.
8. OEM host is able to key up the radio with sufficient output at the antenna.
9. Modem can receive with sufficient signal strength from the antenna port.

NOTE: **Requirements for testing items 1 and 2 are specific to each OEM product. A specific discussion of these items is beyond the scope of this document.**

An automated test script provides more than diagnostic support. When you set up an automated test process, you ensure that only those products that pass the test are labeled for release. For example, since regulatory agencies require product labeling for certification and approval for us, you can develop an automated script to read the modem ID and destination network from the modem and generate a label with the proper inscription.

Equipment Test Set-up

6.1.11 Calibration Tools and Equipment

For any RF testing use GSM Simulators as HP8960 or Rohde & Schwarz CMU200 or equivalent.
For Data test use a standard PC connecting the g18 to the serial port via a Motorola Evaluation board S9002A or use the user equipment.
Line modem.
Use the local network to make the communication.

6.1.12 Set Up the Modem for Testing

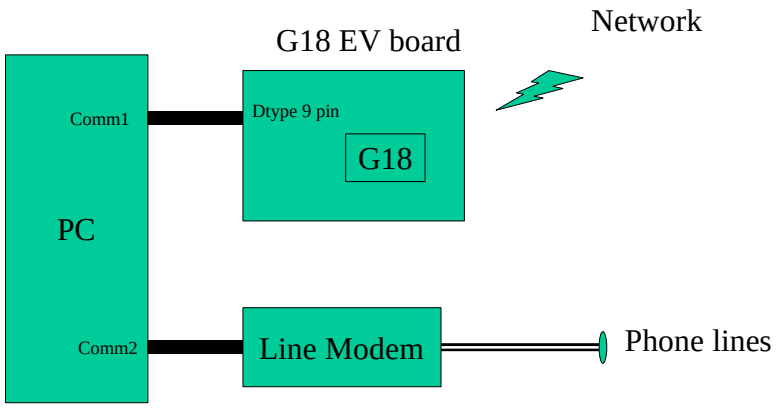


Figure 43 – g18 setup for testing

6.1.13 Loop-back Test

NOTE: **All communication between the DTE (Like the PC) and the DCE (g18 modem) occurs at 57600 bps, no parity, 8 data bits, one stop bit.**
Set the baud rate to 57600 bps by AT+CBAUD=57600.

Used any known file to transfer from comm1 to comm2 or from Comm 2 to Comm 1.
Getting Started

- Verify g18 is On (DSC_EN LED in the EV board will by on).
- Activate two Terminal programs one for Comm 1 and one for comm2.
- Verify that each terminal receive response from the DCE device (send AT and verify OK response).
- Start your test by sending a file from Comm to comm.

Measuring additional parameters

- ATI3 g18 Software version.
- ATI4 Product name.
- AT+CSQ Receive signal quality. Not support Ber information.
- AT+CMER=0,0,1 Show the data on the handset display.

For additional information, consult the Motorola g18 Customer Support Center at:

Help desk phone number is: **+972-3-5684040**
Email : BSH015@email.mot.com

Annex A Glossary -

Abbreviation	Description
ACK	Acknowledgement
ADC	Analog-to-digital converter
ALC	Automatic level control
ANSI	American National Standards Institute
AOC	Automatic output control
ASIC	Application-specific integrated circuit
ATE	Automatic test equipment
BABT	British Approval Board – Telecommunications
BGA	Ball grid array
BER	Bit error rate
BNC	A type of connector used with coaxial cable
bps	Bits per second
BSC	Base station controller (for a network)
C/R	Card Reader
CCR	Type of miniature RF connector
Chebyshev filter	A filter with very sharp cutoff
CHRONOS	Enhanced pendulum IC
CLA	Cigarette Lighter Adapter
CLK	Clock
CMOS	Complementary metal oxide silicon
CNTL	Control
COM	Communications (port)
CPU	Central processing unit
CQA	Customer quality assurance
CNTL	Control (key)
CSA	California Safety Authority
CSD	Circuit Switch Data
DAC	Digital-to-analog converter
Data	TAC‘A type of Motorola data communications system
DB	Decibel
DBc	Decibels relative to carrier
dBm	Decibels mean; levels relative to 1 mW
DCD	Detailed circuit description
DCS	Digital Cellular System (GSM in the 1800MHz band)
DDFTM	Digital Data Fast, a technique that combines an industry-standard error-correction protocol with two compression algorithms (V.42bis and MNP5) to provide data transfer rates up to 33,600bps over a fixed 9,600bps channel

Abbreviation	Description
Debounce	Protection against feedback voltage
Desense	Loss of sensitivity from high ambient noise
DHFA	Digital Hands Free Adapter
DIN	Deutsches Institut Für Normung
DISC	Discriminator
DOS	Disc operating system
DSC	Digital Speech Control
DTE	Data terminal equipment, the user device
DTR	Data terminal ready
DTU	Device under test
DVM	Digital volt meter
ECC	Error Correction and Compression
EEPROM	Electrically erasable, programmable read-only memory
EIA	Electronic Industries Association (U.S.)
EMA	Embedded memory access (mode)
EMI	Electromagnetic interference
EMMI	Electrical Man Machine Interface
EPC	File name suffix for modem configuration files
EPROM	Erasable, programmable, read-only memory
ERP	Effective radiated power
ESD	Electrostatic discharge
ESN	Electronic serial number
EV	Evaluation
EVB	Evaluation board
FCC	Federal Communications Commission (U.S.)
FET	Field effect transistor
FIFO	First in, first out
FNE	Fixed network equipment
FPC	Flexible printed circuit
FracN	Fractional division synthesizer IC
FRU	Field-replaceable unit
FSK	Frequency shift keying
GaAs	Gallium arsenide, a semi-conducting material
GND	Ground
GPIB	A type of ATE interface
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GTEM	Gigahertz transverse electromagnetic
HCT	High-speed CMOS technology
Host	The computer platform, or DTE
HP	Hewlett Packard

Abbreviation	Description
I/O	Input/Output
IB	Inbound
IC	Integrated circuit or Industry Canada
Inbound	Direction of wireless data originating from the host and/or modem to the fixed network equipment
IP	Internet protocol
IR	Infrared
LC	Inductor-capacitor
LED	Light-emitting diode
Li-ion	Lithium ion (battery technology)
LLI	Logical link identifier; unit ID
LNA	Low noise amplifier
MDC	Mobile data communications protocol (Motorola)
ME	Mobile Equipment. e.g. a g18.
MFR	Multiple-frequency reuse
MNP	
MPS	Maintenance Programming Software
NAK	Negative acknowledgment
NatSim	Native Mode Simulation (software utility)
NCL	Native Control Language (Motorola)
NiCad / NiCd	Nickel-cadmium (battery technology)
NiMH	Nickel-Metal-Hydride (battery technology)
NPN	Type of bipolar transistor
NSI	Network systems integration
NVRAM	Non-volatile RAM.
OB	Outbound
OEM	Original Equipment Manufacturer
op-amp	Operational amplifier
OSMT	Type of miniature RF connector
Outbound	Direction of wireless data originating from the fixed network destined for either the host application(s) or the modem itself
Palmtop	A class of small, personal computing devices
PCA	Printed circuit assembly (populated board)
PCB	Printed circuit board (bare board)
PC Card	A PCMCIA product
PCMCIA	Personal Computer Memory Card International Association
PCS	Personnel Communication System (GSM in the 1900MHz band used in North America.)
PDA	Personal data assistant
PDU	Packet data unit
PIC	Personal information communicator
PLL	Phase-locked loop
p/n	Part number

Abbreviation	Description
PMIT	Packet modem integration test
POST	Power-on self test
Ppm	Parts per million
PPP	Point To Point Protocol
QFP	Quad flat pack
R&D	Research and development
RAM	Random-access memory
Rayleigh	A measure of multi-path fading depth of a signal
RC	Resistor-capacitor
RF	Radio frequency
RFI	Radio-frequency interference
RGxxx	Cabling designation number
RLP	Radio link protocol, a sophisticated error-correcting system
RMA	Return material authorization
RNC	Radio network controller
RPM	Radio packet modem
RS-232	The EIA standard for a serial data interface
RSSI	Received signal strength indicator
RTU	Radio Training Utility
Rx	Receive or reception
SAP0	A specific service access point
Schottky diode	A diode with low forward voltage drop and fast switching
SCR	Standard context routing
SDK	Software developers kit
SDU	Service data unit
SFR	Single-frequency reuse
SINAD	Ratio (measured in dB) of signal to noise-plus-distortion
SMA	Sub-miniature connector
SMB	Sub-miniature connector
SMS	Short message service
SNR	Signal-to-noise ratio
SPDT	Single pole, double throw (switch)
SPI	Serial peripheral interface
SRAM	Static random-access memory (static RAM)
TA	Terminal Adapter. Equivalent to DCE. e.g. the g18 module.
TBD	To be determined
TE	Terminal Equipment. Equivalent to DTE. e.g. a laptop computer or OEM device.
TNC	Industry standard connector type
Transorb	Transient absorber
TTO	Transmitter turn-on time

Abbreviation	Description
Tuple	An element of a database relation, consisting of an identifier of an entity and its attributes
Tx	Transmit or transmission
Type III	Reference to a PC Card form factor
UART	Universal asynchronous receiver / transmitter
UL	Underwriters Laboratories
VCC	Voltage common collector
VCO	Voltage controlled oscillator
VDD	Voltage direct drain
Vpp	Voltage peak to peak
VSRAM	Battery backup voltage for SRAM
VSWR	Voltage standing-wave ratio
Wireline	Communications over a direct, physical link
XIP	Execute in place
ZIF	Zero insertion force

Short Message Service abbreviations
The relevant specifications are given in parentheses. (*) stands for a common GSM abbreviations and (-) for a general abbreviation. These abbreviations are often prefixed with a ÒTP-Ó which refers to “Transport Protocol”.

Abbreviation	Description
CM	Call Management (*)
CS	CauSe (-)
DA	Destination Address (-)
DCS	Data Coding Scheme (03.40)
DI	Dialogue Identifier TCAP
GMSCA	Gateway MSC Address
HLR	Home Location Register (*)
IMSI	International Mobile Subscriber Identity (*)
MAL	MSIsdn-Alert (03.40)
MMS	More Messages to Send (03.40)
MR	Message Reference (03.40)
MS	Mobile Station (*)
MSC	Mobile services Switching Centre (*)
MSC	AMSC Address
MSI	Mobile waiting Set Indication (03.40)
MSIsdn	Mobile Station ISDN number (*)
MSM	More Short Messages (09.02)
MSRN	Mobile Station Roaming Number (*)
MT	Message Type (04.11)

Abbreviation	Description
MTI	Message Type Indicator (04.11)
MWS	Message Waiting Set (03.40)
OA	Originating Address (-)
OC	Operation Code (09.02)
PCI	Protocol Control Information (-)
PDI	Protocol DIscriminator (*)
PRI	PRIority (03.40)
RCT	ReCeption Time (03.40)
REA	REcipient Address (03.40)
RL	ReLay function (04.11)
RP	Reply Path (03.40)
SC	Service Centre (03.40)
SCA	Service Centre Address (03.40)
SCTS	Service Centre Time Stamp (03.40)
SM	Short Message (03.40)
SM-AL	Short Message Application Layer (03.40)
SME	Short Message Entity (03.40)
SMI	Short Message Identifier (03.40)
SM-RL	Short Message Relay Layer (03.40, 04.11)
SMS-GMSC	Short Message Service Gateway MSC (03.40)
SMS-IWMSC	Short Message Service Interworking MSC (03.40)
SoR	Status of Report (03.40)
SM-TL	Short Message Transfer Layer (03.40)
SRI	Status Report Indication (03.40)
SRR	Status Report Request (03.40)
ST	STatus (03.40)
TCAP	Transaction Capabilities Application Part (-)
TID	Transaction Identifier (*)
TPDU	Transport Protocol Data Unit (-)
UD	User Data (-)
UDL	User Data Length (03.40)
VLR	Visitor Location Register (*)
VP	Validity Period (03.40)
VPF	Validity Period Format (03.40)

Annex B Customer Specification

Slim

Figure 44: Slim Version

Slim with GPS

Figure 45: Slim with GPS Version

Figure 46: DIN version

Physical

Form factor:	PCMCIA type III, no PCMCIA connector	
Size:	g18 (GPRS) DV Slim:	44.29x88.45x10.4mm (see drawings in this spec)
	g18 (GPRS) DVG with GPS:	44.54x88.45x17.6mm
	g18 (GPRS) DV DIN:	40x80.2x7.5 mm
Mounting:	Four 2.43mm Ø holes provided on non DIN models	
Weight:	g18 (GPRS) DV Slim:	35.5g
	g18 (GPRS) (GPRS) DVG with GPS:	49g
	g18 (GPRS) DV DIN:	22g
Volume:	g18 (GPRS) DV Slim:	36.8 cc
	g18 (GPRS) DVG with GPS:	57.0 cc
	g18 (GPRS) DV DIN:	24.1 cc
Housing material:	Plastic housing PC/ABS	
Interface connector:	g18 (GPRS) DV Slim/ DVG:	36 pin ZIF socket @ 0.5mm pitch ELCO #04-6240-036-800
	g18 (GPRS) DV Horizontal Board Only:	28 pin dual in line pin socket @1.27 pitch (SAMTEC # CLP-114-02-L-D)
RF output connector:	MMCX Jack (female) 50Ω GSM and GPS Mating connectors Plug (Male)	

Coax	Huber-Shuhner	Johnson Components
RG178	11-MMCX-50-1-1	135-3302-001
RG316	11-MMCX-50-2-3	135-3403-001

Environmental

Operational temperature:	-30 to +60 degrees C
Storage temperature:	-40 to +85 degrees C
Shock:	20 g's with 11 millisecond duration, 20 impacts in three mutually perpendicular planes
Vibration:	IS-19: 1.5g acceleration, 5 to 500 Hz @ 0.1 octave/minute in three mutually perpendicular planes

Performance

Operating systems	GSM 900MHz, DCS 1800MHz, PCS 1900MHz.
Voltage:③	3.0 to 6V measured at the I/O connector during the transmit slot (576us out of 4.6ms)
Current:	=7.2 +/- 0.5 mA @ DRX 2 Stand by (sleep) =3.5 +/- 0.5 mA @ DRX 9 Stand by (sleep) < 150uA off current 300mA avg. in call at power level 5 (max. 350 mA) 1.2 A peak @ 217 Hz at power level 5 (max. 1.8A)
Power out:	GSM – Power levels #19 to 5, 5dBm to 33dBm per ETSI. DCS – Power levels # 15 to 0, 0dBm to 30 dBm per ETSI. PCS – Power levels # 15 to 0, 0 dBm to 30 dBm per FCC.
SIM Card Reader:①	Options: 1. Internal - chip SIM CR 3/5V SIM 2. External - Local interface 3/5 SIM 3. External - Remote interface (DSC interface) 5V only
Interface:	Options 9 line RS232 Serial Asynchronous full flow control , 3V logic level (DCE flow direction) Vih 2.0 V min, 5.5 V max Vil 0.8 V max Voh 2.5 V min @100 uA Vol 0.2 V max @ 100 uA Wizard application for running on a PC for running IP over a PPP application Motorola Proprietary DSC Bus GPS interface (TxD, RxD, 1PPS, RTCM, Antenna Voltage), on Slim-GPS model.

Host Protocol:		CSD mode: AT commands including GSM 07.07,GSM 07. 05 (see Developers manual for specific AT commands supported) GRRS mode: AT commands per standard for GSM 07.60 and 07.07 ver 7.5.0. (see Developers manual for specific AT commands supported)
Data:	RS232	RS232 port up to 57.6kbps. The default is set at 9.6 kbps with auto-baud detection active up to 19.2 kbps. For rates above 19.2 kbps the baud rate can be set by At command up to 57.6 kbps, which needs to be reset after each power cycle.
	CSD mode	Over the air rate depending on network, 9.6 kbps max) Circuit Switched Data Note: g18 does not support CSD non transparent with speed less than 4800
	GPRS mode	Over the air data rate depends on coding schemes (CS1-CS4). GPRS packet data (SMG31) Class B (only when a handset is used), multi slot class 1, 2 and 4, 1X (uplink)/1X (downlink) or 1X (uplink)/2X (downlink) or 1X (uplink)/3X (downlink) coding schemes CS1 to CS4
PC FAX:		Class 1 using Winfax, alternate between fax and voice (TS61)
SMS:		Send and receive (PDU and block mode per GSM 07.05)
Voice Call:		Supported I/O with external H/SET
Audio:		Analog - Full duplex I/O on interface connector Digital - Motorola Proprietary DSC Bus Echo cancelling activated by AT or IP for HandsFree Audio applications
GPS:		Independent GPS receiver on GPS model only GPS (TXD, RXD, 1PPS, RTCM, Antenna Voltage) Functions are available on the ZIF and DIN header/socket connector at 3V logic levels. 12 parallel channel L1 1574,42 MHz Code plus carrier tracking (carrier aided tracking) Positional accuracy: 100 meters 2dRMS with SA as per DoD specifications, less than 25 meters SEP without SA Additional specifications available on request

Interface connector, 36 pin description standard, Slim , Slim with GPS and DIN Horizontal

Pin #	Function	PIN #	Function
1	TX Enable	19	SIM CR I/O Data
2	RXD Uart 2 (GPS RXD on GPS models)	20	SIM CR Clock
3	TRD Uart 2 (GPS TXD on GPS models)	21	TS (Turn on/stand by) ⑤
4	RS232 – TXD ⑦	22	DSC - Enable
5	RS232 – RXD⑧	23	DSC - Downlink
6	RS232 – DTR	24	DSC - Uplink
7	RS232 – DCD for CSD call/PDP context indicator ⑩	25	Analog Audio GND
8	RS232 – RTS	26	GND
9	RS232 – CTS	27	GND
10	RS232 – DSR	28	GND
11	RS232 – RI	29	GND
12	Man test	30	Vcc (3.0 – 6 Vdc)
13	Analog Audio In	31	Vcc (3.0 – 6 Vdc)
14	Analog Audio Out and Power on/off ⑥	32	Vcc (3.0 – 6 Vdc)
15	Wake up/GPRS coverage indicator ⑨	33	Vcc (3.0 – 6 Vdc)
16	Input I/O (custom definition) & SIM CR DET ④	34	GPS Ant. PWR (3/5 Vdc)
17	SIM CR Vcc (3/5Vdc)	35	RX for differential GPS RTCM
18	SIM CR Reset (RST)	36	GPS 1 pps

Functions on pin numbers 2,3,34,35 and 36 on units with GPS only
wake up line functionality - See 3.1.2

Interface connector, 28 pin description DIN models

Pin #	Function	Pin #	Function
1	Vcc (3.0 – 6) Vdc	15	TXD Uart 2
2	Vcc (3.0 – 6)Vdc	16	RXD Uart 2
3	SIM CR I/O Data	17	Analog Audio GND
4	SIM CR Reset (RST)	18	Analog Audio Out and Power on/off ⑥
5	SIM CR Vcc (3/5Vdc)	19	Analog Audio In
6	SIM CR DET	20	DSC - Enable
7	RS232 – DTR	21	RS232 - DSR
8	TS (Turn on/stand by) ⑤	22	DSC - Downlink
9	Man test	23	DSC - Uplink
10	Wake up/GPRS coverage indicator ⑨	24	SIM CR Clock
11	GND	25	RS232 – TXD ⑦
12	GND	26	RS232 - RXD ⑧
13	RS232 – RI	27	RS232 - CTS
14	RS232 – DCD for CSD call/PDP context indicator ⑩	28	RS232 - RTS

① One SIM card can be used with option 1 and 2. With option 3 two SIM cards can be in the system. When connecting the remote card reader to evaluation board use handset connector.

② When using Motorola head set SYN4937A and SYN6962A; evaluation board demonstrates this implementation.

③ It is recommended that a 1000 uF capacitor be placed across GND and VCC as close as possible to the flex cable on versions with a housing or the 28 way connector on the DIN version. This will prevent Vcc drop during peak current, which has a 543µs duration every 4.3ms due to GSM power pulses. Voltage must not drop below 3.0vdc or the performance of the module will be degraded.

④ Custom definition will be considered for specific applications.

⑤ Logic high will turn unit on, logic low put the unit into stand by mode. You must turn unit on before placing unit into standby mode. An alternate way to power the radio on is by using the On/Off pin

⑥ The Audio Out line is used to send out the detected audio and as a toggle On/Off pin.

⑦ Data received by g18 (DCE flow)

⑧ Data sent from g18 (DCE flow)

⑨ Wake up line is bi – directional

When going from non GPRS coverage to GPRS coverage, a negative pulse will be generated on this line

When the g18 wants to send data to the DTE (host), a negative pulse will be generated on this line

When DTE (host) wants to send data (while the g18 is in sleep mode) it can send a wake up to the g18

⑩ GPRS PDP context active – DCD line will be active (low)

GPRS PDP context not active – DCD line will be inactive (high)

Standard, Slim, Slim with GPS and DIN horizontal models Functions available on 36 pin ZIF

VCC input	3.0 to 6Vdc
Full RS232 - 9 pins	TXD, RXD, RTS,CTS, DSR, DTR,DCD RI at 3V levels
External SIM connections	SIM Clock, SIM reset, SIM I/O, SIM VCC,SIM PD
DSC bus	DSC_EN, Downlink, Uplink Motorola proprietary BUS
Audio In/Out	Audio out and On/Off in the same pin, audio in Signal and analog ground
Man_Test line	Used to detect standard Motorola accessories
TS line (mobport).	Used to turn on the radio when Vcc is applied
TX_EN line	This line is an indication when the radio is transmitting - Open Drain
GPS (GPS option only)	TXD & RXD in 3V levels, 1PPS, RTCM, Antenna power. RXD and TXD lines are at 3V levels. The GPS receiver is the Motorola M12

Data & Voice (Slim) - Connections

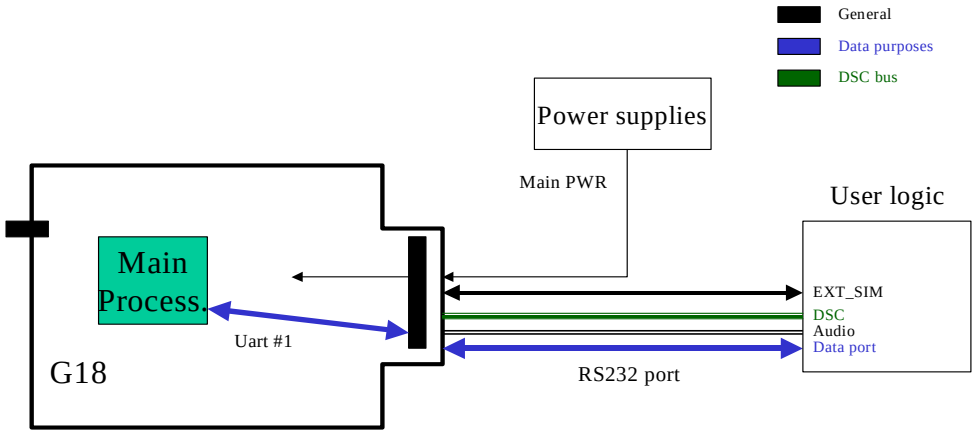


Figure 47 - Data & Voice (Slim) - Connections

Data & Voice + GPS model - Connections

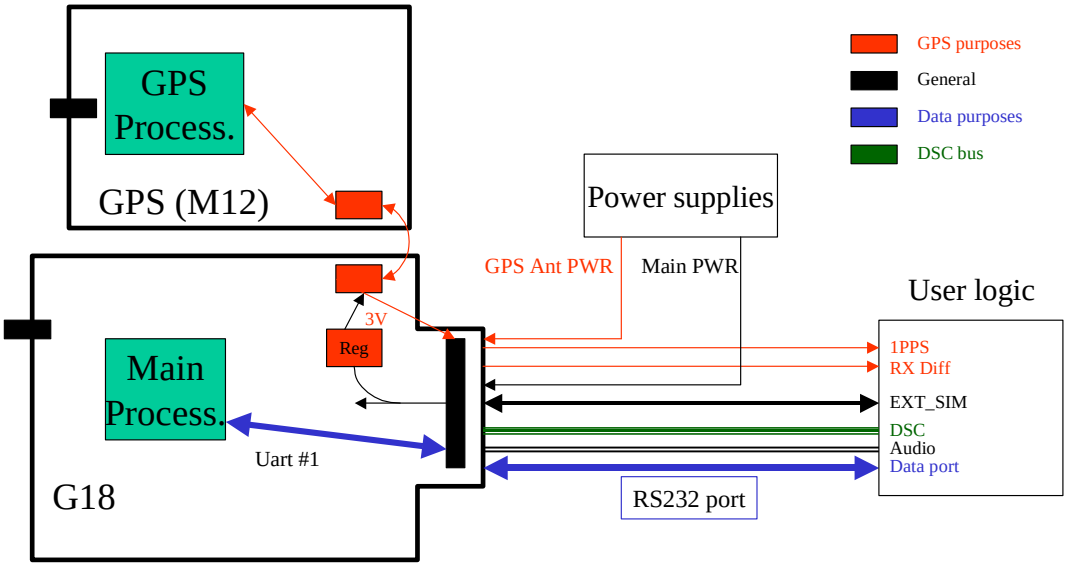


Figure 48 - Data & Voice + GPS model - Connections

DIN model and horizontal Functions available on 28 pin ZIF

VCC input	3.0 to 6Vdc
Full RS232 - 9 pins	TXD, RXD, RTS,CTS, DSR, DTR,DCD RI at 3V levels
External SIM connections	SIM Clock, SIM reset, SIM I/O, SIM VCC,SIM PD
DSC bus	DSC_EN, Downlink, Uplink Motorola proprietary BUS
Audio In/Out	Audio out and On/Off in the same pin, audio in Signal and analog ground
Man_Test line	Used to detect standard Motorola accessories
TS line (mobport).	Used to turn on the radio when Vcc is applied
TX_EN line	Not available in DIN connector

Data & Voice in DIN configuration- Connections

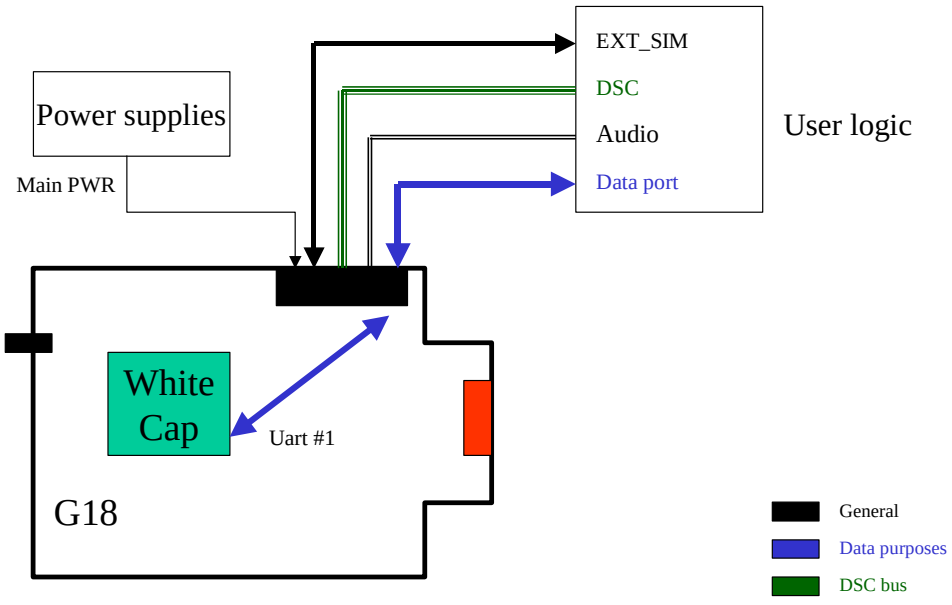


Figure 49 - Data & Voice in DIN configuration - Connections

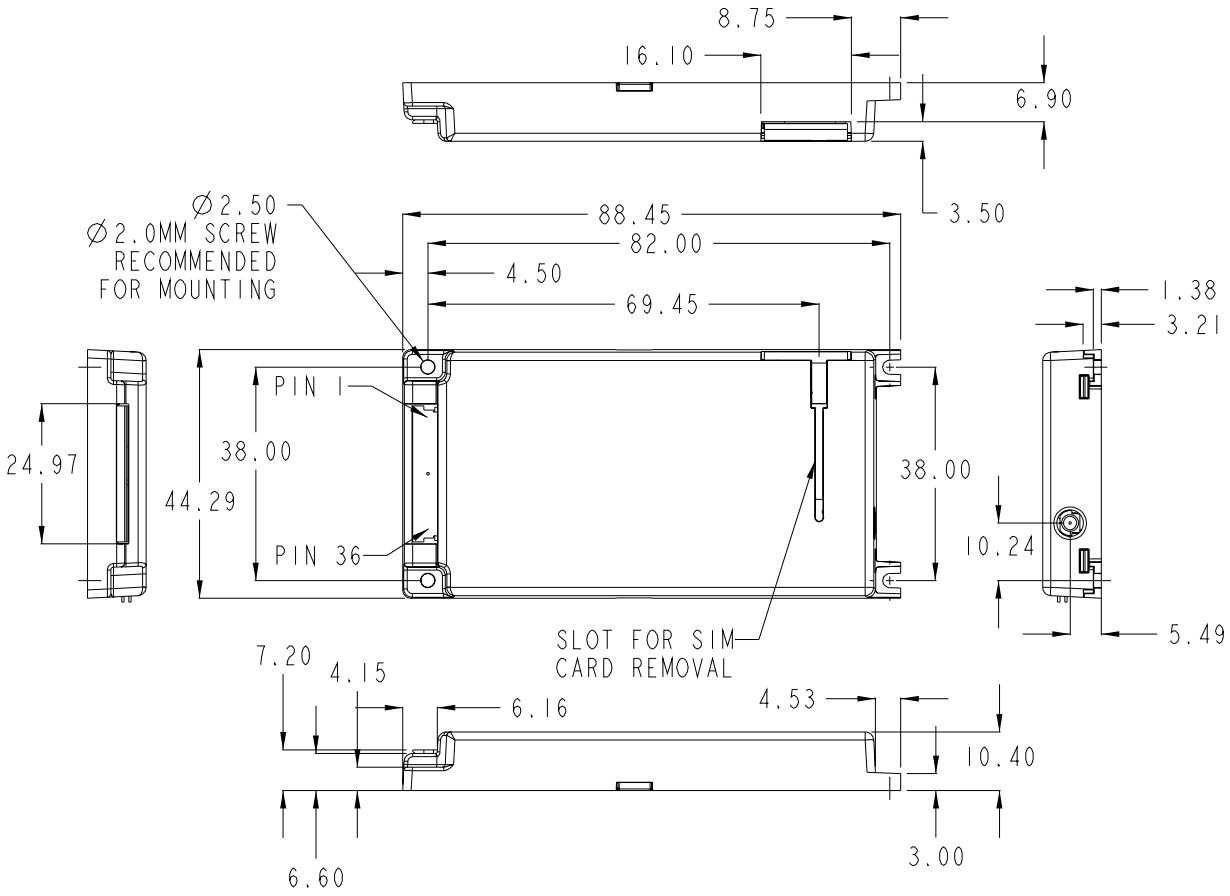


Figure 50 - g18 DV Slim

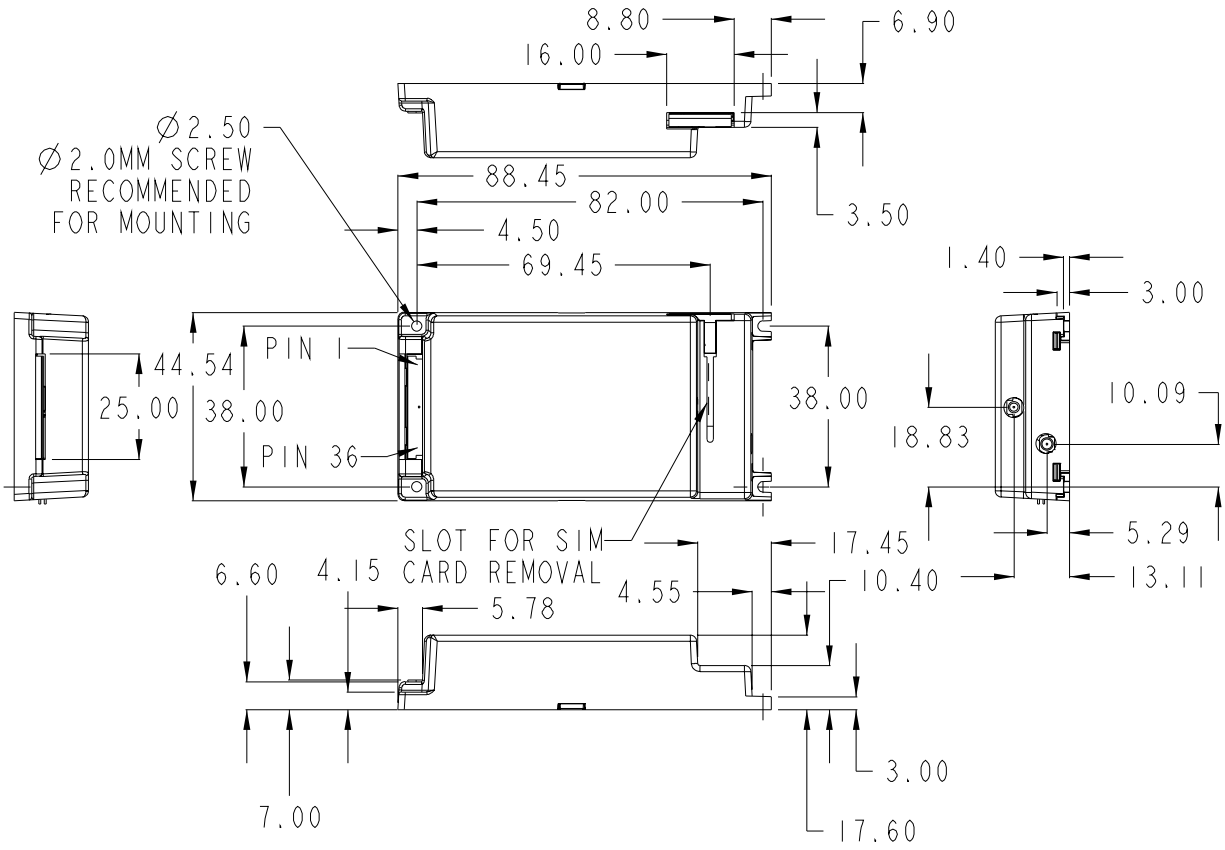


Figure 51 - g18 DV Slim with GPS

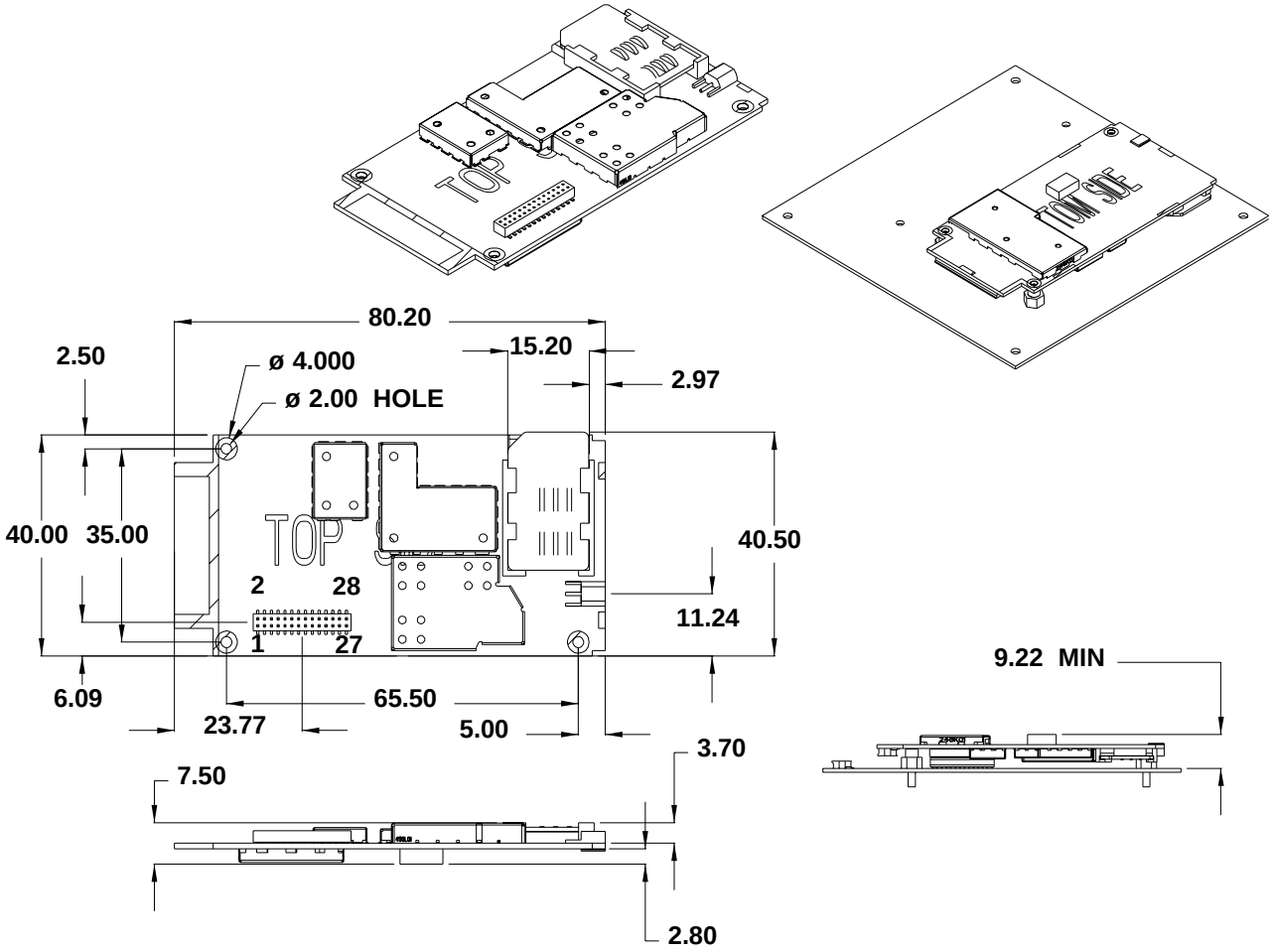


Figure 52 - g18 DV DIN Horizontal

g18 Model numbers and languages supported

Language pack Description	Language 01 Western Europe	Language 03 GSM 1900 NA	Language 06 Nordic	Language 07 East Europe	Language 08 Mid East	Language 08 Mid East Arabic
g18 DV slim	SE2836xF5Z8	SE2836xF5Z6	SE2836xF5Y5	SE2836xF5Y6	SE2836xF5Z5	SE2841xF5Z5
g18 DV slim w/GPS	SE2837xF5Z8	SE2837xF5Z6	SE2837xF5Y5	SE2837xF5Y6	SE2837xF5Z5	SE2842xF5Z5
g18 DV DIN Horz	SE2838xF5Z8	SE2838xF5Z6	SE2838xF5Y5	SE2838xF5Y6	SE2838xF5Z5	SE2843xF5Z5
Languages						
Arabic					X	X
Bulgarian				X		
Chinese-Complex						
Chinese-Simplified						
Croatian				X		
Czech				X		
Danish	X		X			
Dutch	X				X	X
English	X		X	X	X	X
English-American		X				
Estonian			X			
Finnish	X		X			
French	X				X	X
French-Canadian		X				
German	X	X		X	X	X
Greek	X				X	X
Hebrew					X	X
Hungarian	X					
Indonesian-Bahasa						
Italian	X	X			X	X
Latvian			X			
Lithuanian			X			
Norwegian	X		X			
Polish				X		
Portuguese	X	X				
Romanian				X		
Russian			X		X	X
Serbian				X		
Slovak				X		
Slovenian				X		
Spanish	X					
Spanish-American		X				
Swedish	X		X			
Thai						
Turkish	X				X	X
Ukrainian			X			
Vietnamese w/tonal marks						

Annex C User Manual

1. Basic Functionality

Make sure that the g18 is mounted and linked correctly to the developer board. The power supply must provide 3-6VDC without a any voltage spikes!
Use Telex or any other Terminal program on your computer and set it to normal RS232 connection (one to one connection cable to be used)
After all links have been established correctly, power the board by means of the power switch.

1.1 PIN and PUK Code Entry

In case your SIM card requests a PIN number, do the following:

AT Command	Reaction	Remark
at+cpin=”nnnn”	SIM card should be enabled	nnnn = PIN number; if PIN is correct “OK” is shown if PIN is incorrect “ERROR” is shown (4 - 8 digits)
at+cpin?	should respond with information about SIM and PIN	When no SIM is available: +CPIN: INSERT CARD When PIN is not needed: +CPIN: READY When PIN is needed : +CPIN: SIM PIN When PUK number is needed +CPIN: SIM PUK When wrong PIN entered: +CPIN: SEEM BAD CODE When right PIN entered: +CPIN: SEEM_SUCCESS When SIM blocked : +CPIN: SIM PERM PUK When bad SIM : +cpin: CHECK CARD

G1 is the following AT commands group:

1. Basic AT command (includes ATD, ATA, ATH).
2. AT+CKPD (to simulate handset key strokes).
3. AT+CMER (to get handset screen output).

G2 is AT command group which interact with ME that are accepted when ME is pending SIM PIN, SIM PUK or PH-SIM (GSM 7.07 section 8.3) :

+CGMI, +CGMM, +CGMR, +CGSN, +CPAS, +CPIN.

SIM/PIN status	Allowed commands	AT command result for non-allowed commands	+CPIN? Result	+CPIN? Code output
No SIM	G1	SIM Not inserted	SIM Not inserted	-
Bad SIM	G1	SIM Failure	SIM Failure	-
Required SIM Card PIN	G1, G2	SIM PIN Required	OK	SIM PIN
PIN1 Blocked	G1, G2	SIM PUK Required	OK	SIM PUK
Permanent Blocked (PUK)	G1	SIM Failure	SIM Failure	-
PIN2 required	All	Depends on AT command	OK	SIM PIN2
PIN2 blocked	All	Depends on AT command	OK	SIM PUK2
Permanent Blocked (PUK2)	G1	SIM Failure	SIM Failure	-
Other	All	Depends on AT command	OK	READY

The following AT commands are enabled without a valid SIM: GCAP, GMI,GMR, IFC, CEER, CGMI, CGMM, CGMR, CGSN, CHUP, CIPE, CKPD, CMEE, CMER, CIP, CRC, CSQ, CR, MTDTR

1.2 Feedback from the system

At Command	Reaction	Remark
ati3	should provide SW version	e.g. E6.02.07
at+cgmr	should provide hardware information	PC Card: g18_v_E6_02_07
at+cgmi	should provide hardware information	+CGMI: “MOTOROLA”
at+cnum	subscriber number	+cnum: “VOICE”,”054445561”,129 +cnum: “DATA”,”054626515”,129 +cnum: “FAX”,”054562511”,129
at+cops?	provides network operator name	e.g. +COPS: 000, 000, “IL ORANGE”

at+csq	should provide signal strength indication e.g. +csq: 031,099	e.g. +CSQ: 030, 099 Note : not support Ber information
at+cmee=1 or 2	report mobile equipment error should always be set to2	0 = disabled 1 = enabled 2 = enabled
at+cmer	Mobile equipment event reporting to IP	e.g. AT+CMER=0,0,1,1,0

1.3 How to establish a Voice Call

The following procedure shows the basic commands to be send to the g18 to establish a voice call.

At Command	Reaction	Remark
at+cpin=”xxxx”	g18 should power up SIM card should be enabled	DSC LED must light xxxx = PIN number (4 - 8 digits)
ATD(phone number); or ATD*(phone number) or ATD> <index>; or ATD> <”name”> or ATDS=n (n=0 to 3) or ATD><mem><index>;	dial to phone number (Voice call)e.g. ATD123456; ATD>102; OR ATD>”DAN” OR ATDS=1; OR ATDS=0 OR ATD>SM101;	-Ok -Busy -No Answer -No Carrier
Atdl	Redial last number	only voice calls possible
at*dxxxx	Current call is a voice call	
Ath	hang up	Note: In Multy-party call, ATH does not end the last call, only AT+CHLD=1 does.

Note:
In voice call, when the other side hangs up, DTE will get “NO CARRIER” message.

1.4 How to answer a Voice Call

The following procedure shows the basic commands to be send to the g18 to answer a voice call

AT Command	Reaction	Remark
at+cpin=”nnnn”	g18 should power up SIM card should be enabled	nnnn = PIN number (4 - 8 digits)
ata	answer call	

1.5 How to find a phonebook entry

At Command	Reaction	Remark
	g18 should power up	
at+cpin=”nnnn”	SIM card should be enabled	nnnn = PIN number (4 - 8 digits)
at+cpbs=“mt“	Enables the phone and SIM memory	
at+cpbf= “Name”	g18 shows the number on that position +cpbr: xxx, “phone number“, yyy, “Name of the entry“	The “NAME” is up to 3 characters string xxx = position in the phone memory 0-100 101-220 in SIM yyy= 129 normal number yyy= 145 international number

1.6 Write a phonebook entry

At Command	Reaction	Remark
	g18 should power up	
at+cpin=”nnnn”	SIM card should be enabled	nnnn = PIN number
at+cpbs=“mt“	Enables the phone and sim memory	
at+cpbw=xxx,“ Phone number“, yyy, “Name of the entry“	g18 writes the number on that position	<xxx> position in the memory 0-100 Phone Memory 101-220 SIM card Memory <yyy> 129 normal number 145 international number

1.7 Read a phonebook entry.

At Command	Reaction	Remark
	g18 should power up	
at+cpin= ”nnnn”	SIM card should be enabled	nnnn = PIN number
at+cpbs= “mt“	Enables the phone and sim memory	
at+cpbr= xxx	g18 shows the number on that position +CPBR: xxx, “phone number“, yyy, “Name“	**<xxx>** position in the memory 000-100 In the Phone 101-220 In SIM Card **<yyy>** 129 normal number 145 international number

1.8 Phone book function

At Command	Reaction	Remark
at+cpbs=”NN”	this at should be the first one to be used to select the phone book	“FD” = SIM fix dialling phonebook “LD” = last dialling phonebook “ME” = ME phonebook “MT” = ME and SIM phonebook “SM” = SIM phonebook “DD” = Direct Dial phonebook “RC” = ME received calls list “MC” = ME missed calls list
at+cpbs?	e.g. +CPBS: “SM”,45, 100	
at+cpbs=?	+CPBS: (“FD”,”LD”,”ME”,”MT”, ”SM”,”DD”,"RC","MC")	list of supported memory
at+cpbr= xxx	e.g. at+cpbr=101 +CPBR: 101,”123456”,129,”AVI”	xxx is a number 0-100 for reading from ME phonebook and 101-220 for reading from SIM phone book

1.9 How to send a SMS in PDU mode

At Command	Reaction	Remark
	g18 should power up	
at+cpin=”nnnn”	SIM card should be enabled	nnnn = PIN number
at+csms=<service>	select message service response: +CSMS: <mt>,<mo>,<bm> +CSMS: 001,001,001 OK	**<Service>** 0 for phase 2 1 for phase 2+ **<mt>,<mo>,<bm>** 1 supported 2 not supported
at+cpms=”sm”	preferred message storage response: +CPMS:<used1>,<total1>,<used2>,<total2> +CPMS: 001,0015,001,015 OK	
at+cmgs=160 >0791947122720 00011000c91947 1628128430000a 704f4f29c0e ctrl-z	send SMS in PDU mode return: +CMGS: 000	send “TEST” to phone # 49-172- 6188234 to SMS center 49-172- 2720000 coding of SMS see attached document.

1.10 How to establish GPRS PDP context

For using the GPRS Network for HTTP/FTP browsing, you must be "attached" to the GPRS Network before the activation of PDP context.

Attachment may be done by 2 ways:

- Automatically after power up of your MS. On the screen you should see "GPRS" logo (With LEAP phone we saw it).
- Using the AT+CGATT=1 command
  You can check your attachment status by using the AT+CGATT? Command.

AT+CGDCONT=1,"IP","RTY","123.32.45.9

There are 3 main ways to activate PDP context.
1) If we use GPRS Wizard application , after "DOUBLE CLICK" on the button predefined as dialler for this provider, PDP context will be done automatically .
If the g18 was not attached to GPRS before, it will be attached automatically.

Configuration of the setup
Enter into the wizard parameters received from your operator.
Set definitions to allowed your http\ftp browser to use G18 as port to web.
usage

1. Open the GPRS wizard
2. Double click on the dialler icon to select and activate the provider you choose (you can have more then one provider in your list)
3. On the handset you will see after end of dialling your temporary IP address and then the "GPRS DATA Session" message.
4. You can minimized your GPRS wizard window and use your http\ftp browser (Internet explorer, netscape …)

2) If we use AT commands to activate PDP context, you must do the following steps:

- Define PDP contact (profile) for example: AT+CGDCONT=1,"IP","RTY",""
- Define Quality of service. for example: At+CGQREQ=3,2,4,5,8,12
- Define minimum acceptable Quality of service. For example: At+CGQMIN=1,0,,0,0,0
- Activation of PDP context via AT+CGACT=1 command.

Configuration and setup:

```
AT+CGQMIN=1,0,0,0,0,0
AT+CGQREQ=1,0,0,0,0,0
AT+CGCONT=1,"IP","APN","0.0.0.0",0,0   // "APN" – replace it with the provider
                                       //  name
AT
AT &F0 &D2 &C1 E0
AT V1 W1 S95=47
AT&K3
ATD*99#
```

The above list is only for the AT commands level. PPP information (DNSs,) is not shown here

3) Using ATD* command set:

- For selecting the provider, protocol and the profile use: ATD*99*(APN)*(protocol)*(CID)#

Actually providers use : ATD*99# command to connect for their GPRS service.

2. AT Command Listing

2.1 ATD, Dialling

At Command	Reaction	Remark
atd<number> ATD(phone number); or ATD*(phone number) or ATD> <index>; or ATD> <"name"> or ATDS=n (n=0 to 3) or ATD><mem><index>; ATDL ATD*99 ATD*100	<busy>, <no carrier>	**<number>** Data/Fax number **<busy>** Called party is not available **<no carrier>** No connection to the number For Voice call ONLY Request GPRS service "D" Manual acceptance of a network request.
at*d xxxxxx	Current call is a voice call	

at*d06113611404
OK

OK // When the call connected

atd06512467; //Another format for voice call
atdl
OK

OK // When the call connected

atd06113611404 // Data call
OK
BUSY

atd06113611404 // Data call
OK

atdl // Dialing of last number
OK

atdl // Dialing of last number
OK
NO CARRIER

atdl // Dialing of last number
OK
BUSY

2.2 AT+CAOC, Advice of charge

At Command	Reaction	Remark
at+caoc <mode>	+caoc: <xxxx>	**<mode>** 0 = Query CCM value **<xxxx>** actual price of the current call (hex)

at+caoc=? Note: this command needs
+CAOC: 0 support of the local network
OK

at+caoc=0
+CAOC: 000000
OK

2.3 AT+CCFC, Call forwarding number and conditions

At Command	Reaction	Remark
at+ccfc = <reason>,<mode>[,<number>[,<type>[,<class>[,<subaddr>[,<satype>[,<time>]]]]]] at+ccfc=?	+CCFC: (0,1,2,3,4,5) returns all reasons supported	**<Reason>** 0 Unconditional 1 Mobile busy 2 Not reply 3 Not reachable 4 All call forwarding 5 All conditional call forwarding **<Mode>** 0 Disable 1 Enable 2 Query status 3 Registration 4 Erasure **<Type>** 145 - international phone 129 – Regular phone number **<Time>** 1-30 for waiting when “no reply” before call is forwarded (default) **<Class>** 7 equals to all classes

Note:
Third parameter must be a number multiply of 5 (0,5,10,...)
at+ccfc=5,2 and at+ccfc=4,2 are not supported by network.
3. First registration mode also enables the call forward

AT+CCFC=?
+CCFC: (0,1,2,3,4,5)

OK
AT+CCFC?
+CME ERROR: "operation not allowed"

at+ccfc=0,3,"01256316830",129,1

OK
AT+CCFC=0,2

+CCFC: 1,1,"+441256316830",1
+CCFC: 0,2
+CCFC: 0,4

OK
at+ccfc=0,4,,,1

OK

2.4 AT+CCWA, Call waiting

At Command	Reaction	Remark
at+ccwa=<n>, <mode>, <class x>	Enables the call waiting feature	<n>shows the result code in TA 0 Disable 1 Enable **<mode>** 0 Disable 1 Enable 2 Query **<status>** 0 Not active 1 Active **<class x>** 1 Voice 2 Data 4 Fax.

Note:
Unsolicited result code does not include alpha tag within the double-quote.

At+ccwa=?
+ccwa: 00,01
OK
at+ccwa=?
+CCWA: 0
OK
at+ccwa=0,0
OK
at+ccwa=0,2
+ccwa: 0,1
+ccwa: 0,2
+ccwa: 0,4
OK

at+ccwa=1,1
OK

at+ccwa=1,2
+ccwa: 1,1
+ccwa: 1,2
+ccwa: 1,4
OK

2.5 AT+CHLD, Call related supplementary services

At Command	Reaction	Remark
at+chld=<mode>	Switching between the active calls	**<mode>** 0 Releases all held calls or sets User Determined User Busy (UDUB) for a waiting call. 1 Releases all active calls (if any exist) and accepts the other (held or waiting) call 1X Releases a specific active call X. 2 Places all active calls (if any exist) on hold and accepts the other (held or waiting) call. 2X Places all active calls on hold except call X with which communication shall be supported. if there is no such call, returns error 22 3 Adds a held call to the conversation.

CALL STATE (+CLCC)	+CHLD modes					
	CHLD = 0	**CHLD = 1**	**CHLD = 1X**	**CHLD = 2**	**CHLD = 2X**	**CHLD = 3**
IDLE	error 3	error 3	error 3	error 3	error 3. if there is no such call, returns error 22	error 3

SINGLE ACTIVE	error 3	release active	whan X = 1 release active. else, returns error 22	put call on hold	error 3. if there is no such call, returns error 22	error 3
MPTY ACTIVE	error 3	release mpty call returns 2 "no carrier" when there are 2 outgoing calls.	release a specific call x. if there is no such call, returns error 22	put mpty on hold	split. if there is no such call, returns error 22	error 3
INCOMING CALL	release incoming call	error 3	error 3	error 3	error 3. if there is no such call, returns error 22	error 3
ACTIVE + WAITING	release waiting call	release active, accept waiting	release a specific call x. if there is no such call, returns error 22	put active call on hold, accept the waiting call	error 3. if there is no such call, returns error 22	error 3
MPTY ACTIVE + WAITING	release waiting call	release mpty, accept waiting	release a specific call x. if there is no such call, returns error 22	put mpty on hold, accept the waiting call	split. if there is no such call, returns error 22	error 3
SINGLE HELD	release held call	accept held call	release a specific call x. if there is no such call, returns error 22	accept held call	error 3. if there is no such call, returns error 22	error 3
HELD MPTY	release held call	accept mpty call	release a specific call x. if there is no such call, returns error 22	accept mpty call	error 3. if there is no such call, returns error 22	error 3
DUAL	release held call	release active, accept the other call	release a specific call x. if there is no such call, returns error 22	switch	error 3. if there is no such call, returns error 22	make a conference call
DUAL + MPTY ACTIVE	release held call	release mpty, accept the other call	release a specific call x. if there is no such call, returns error 22	switch	error 3. if there is no such call, returns error 22	make a conference call
DUAL+ MPTY HELD	release held call	release active, accept the mpty	release a specific call x. if there is no such call,	switch	error 3. if there is no such call, returns error	make a conference call

			returns error 22		22	
HELD + WAITING	release waiting call	accept the waiting call	release a specific call x. if there is no such call, returns error 22	accept the waiting call	error 3. if there is no such call, returns error 22	error 3
HELD MPTY + WAITING	release waiting call	accept the waiting call	release a specific call x. if there is no such call, returns error 22	accept the waiting call	error 3. if there is no such call, returns error 22	error 3
DUAL + WAITING	release waiting call	release active, accept waiting call	release a specific call x. if there is no such call, returns error 22	error 3 (too many calls on hold)	error 3. if there is no such call, returns error 22	join the dual calls.
DUAL + MPTY ACTIVE + WAITING	release waiting call	release mpty active, accept waiting call	release a specific call x. if there is no such call, returns error 22	error 3 (too many calls on hold)	error 3. if there is no such call, returns error 22	join the dual and the mpty calls
DUAL + MPTY HELD + WAITING	release waiting call	release active, accept waiting call	release a specific call x. if there is no such call, returns error 22	error 3 (too many calls on hold)	error 3. if there is no such call, returns error 22	join the dual and the mpty calls

Notes:

1. Split = place all active call on hold except a specific call.
2. Switch = put active on hold and accept the held call
3. Error 3 - "operation not allowed"
4. Error 22 - " not found"

at+chld=?
+CHLD: (0,1,1X,2,2X,3)
OK.
RING

ata
OK

at+chld
+CME ERROR: operation not allowed

at+chld
NO CARRIER

at+chld=2
+CME ERROR: operation not allowed

at+chld=0
OK

at+chld=1
OK

at+chld=1
OK
RING

at+chld=1x
OK
NO CARRIER

at+chld=1
OK
NO CARRIER
RING

at+chld=2
OK

at+chld="
+CME ERROR: operation not allowed

at+chld=2
NO CARRIER

at+chld=2
OK

2.6 AT+CLCC. List current calls

At Command	Reaction	Remark
at+clcc at+clcc=? at+clcc?	+CLCC: <id1>,<dir>,<call state>,<mode>,<mpty>[, <number>,<type> OK +CLCC: 0 or +CLCC: 1	**<Direction>** 0 Mobile Originated call 1 Mobile Terminated call **<Call State>** 0 Active 1 Held 2 Dialling 3 Alerting 4 Incoming 5 Waiting 6 Release **<Mode>** 0 Voice Call 1 Data 2 Fax 3 Voice followed by data, voice mode 4 Alternating voice/data, voice mode 5 Alternating voice/fax, voice mode **<Multiparty>** 0 Call is not part of a conference call 1 Call is one of multiparty call parties **<Phone Number>** **<Type>** 129 Normal 145 With international access character +

Note:
1. Alpha string from phone book is not displayed.
2. Add non standard "released" state.
3. Asynchronous answers are also allowed, by using at+clcc=1
4. In the Release state, the call Mode will always be zero.

AT+CLCC=?

OK

AT+CLCC?

+CME ERROR: "operation not allowed"

at*d01256316830

OK

OK
AT+CLCC

+CLCC: 0,0,0,0,0,"01256316830",0

OK
AT+CHUP
NO CARRIER

2.7 AT+CLCK, Facility lock

At Command	Reaction	Remark
at+clck=<facility>, <mode>[,<password> [,<class>]]	*+CME ERROR: <err>* **when <mode>=2 and command successful:** +CLCK: <status>, <class1>	**<Facility>** CS - key pad SC - SIM Card AO - Bare all outgoing calls OI – Bare outgoing international calls OX - Bare outgoing international calls except to Home country AI - Bare all incoming calls IR - Bare incoming calls when roaming outside Home country AB - All barring services AG - All outgoing barring services AC - All incoming barring Services FD - SIM fixed dialling feature **<Mode>** 0 - Unlock 1 - Lock 2 - Query status **< Password>** Call Barring password or PIN1 to Lock/ Unlock SIM or PIN2 for SIM Fixed Dialling Feature **<Class>** Sum of integers representing of information for call barring services 1 - Voice 2 - Data 4 – Fax <Status> 0 - not active 1 - active
at+clck=?	+CLCK: (list of supported facilities)	

AT+CLCK=?
+CLCK: ("CS","SC","AO","OI","OX","AI","IR","AB","AG","AC","FD")

OK
AT+CLCK?

+CME ERROR: "operation not allowed"

AT+CLCK="CS",2

+CLCK: 0,7

OK

AT+CLCK=”FD”,2

+CLCK: 0,7 // means that write operations into FD area are possible if PIN2 was entered at least once after power up.
OK

2.8 AT+CLIP, Calling line identification presentation

At Command	Reaction	Remark
at+clip <n>,<m>	Show the number of the calling party	**<n>** 0 = disable 1 = enable **<m>** 0 = Clip not provisioned 1 = Clip provisioned 2 = unknown

at+clip=1
OK
RING
+CLIP: "+496113611404",145
RING
+CLIP: "+496113611404",145

at+clip=?
+CLIP: (000,001)
OK

at+clip=0
OK
RING

2.9 AT+CLIR, Calling line identification

At Command	Reaction	Remark
at+clir =<n> at+clir? at+clir=?	Shows the own number at the called party +clir: <n>,<m> +clir: (list of supported <n>s)	**<n>** 0 Used according to the subscription of the clir service 1 Enable 2 CLIR suppression in permanent mode **<m>** 0 Clir not provisioned 1 Clir provisioned 2 unknown 3 Clir temporary restricted 4 Clir temporary allowed

at+clir=?
+CLIR: (0,1,2)
OK

at+clir?.
+clir: 000,004

at+clir=2
OK

at+clir?
+clir: 002,004

2.10 AT+CMEE, Report mobile equipment

At Command	Reaction	Remark
at+cmee <n>	Shows an error description	**<n>** 0 Disable 1 Enable (numeric) 2 Enable (verbose)

at+cmee?
+CMEE: 000
OK

at+cmee=?
+CMEE: (0-2)
OK.

at+cmee=1
OK

at+cmee?
+CMEE: 1
OK

at+cmee=2
OK

at+cmee?
+CMEE: 2
OK

2.11 AT+CMGS, Send SMS message

At Command	Reaction	Remark
(cmgf=0) at+cmgs=<length> <cr> >PDU is given <ctrl-z/ESC>	Send SMS message and the message is terminated with control-Z character (0x1A)	**<length>** number of octets coded in the TP **<cr>** after terminating with<cr> PDU can be given from TE **<crtl-z>** indicate ending of PDU

2.12 AT+CNUM, Subscriber number

At Command	Reaction	Remark
at+cnum	list of subscriber number for voice, data & fax.	

at+CNUM=?
OK

at+CNUM
+CNUM: “voice”, “054556426”, 129
+CNUM: “data”, “054667739”, 129
+CNUM: “FAX”, “054422417”, 129

at+CNUM=?
+CNUM: “voice”, “054525215”, 129
+CNUM: “data”, “054215155”, 129
+CNUM: “FAX”, “054626618”, 129
OK

2.13 AT+COPS, Operator selection

At Command	Reaction	Remark
at+cops=<mode>,<format>, <oper>	Selects operator	**<mode>** 0 Automatic 1 Manual
at+cops=?	+COPS: list of supported (<stat>, long alpha numeric <oper>, short alphanumeric <oper>, numeric <oper>)	**<present>** 2 Deregister from network 3 Set only <format> 4 Manual/automatic
at+cops?	+COPS: <mode>,<present>,<oper>	**<format>** 0 Long alphanumeric 1 Short alphanumeric 2 Numeric
		<Operator status> 0 Unknown 1 Available 2 Current 3 Forbidden

Notes:
1. When using set command (=) and not entering <oper> the respond will be OK but no action will be done. (at+cops=<mode>,<format><cr>, the respond is OK).
2. When manually de-registering from the network using AT+COPS=1,2, the phone automatically searches for a new network and logs in.

at+cops=?
+COPS: (2,"","D2 PRIVAT","26202"),(0,"","A1","23201"),(0,"","F SFR","20810"),(0,"","GR PANAFON","20205"),(0,"","S EURO","24008"),(0,"","EUROTEL-CZ","23002"),(0, "","NL LIBERTEL","20404"),(0,"","I OMNI","22210"),(3,"","D1-TELEKOM","26201"),,(0,1,2,3,4),(0,1,2) OK

at+cops?
+COPS: 0,0,"D2 PRIVAT"
OK

at+cops=0
OK

at+cops=1
OK

at+cops=1,0,d1-telekom
+CME ERROR: 027

at+cops=1,1,d02
OK
BUSY

at+cops=1,0,d2
privat +CME ERROR: 027

at+cops=1,1,d01
+CME ERROR: 100

at+cops=2
OK

at+cops=3
OK

at+cops=4
OK

at+cops=4,2,d01
OK
BUSY

at+cops=4,226202
OK

at+cops=4,2,26201
ERROR

at+cops=4,0,"D1-Telekom"
ERROR
at+cops=4,1,d01
OK

BUSY

at+cops=4,1,d01.
OK
BUSY

at+cops=4,0,d1-telekom
ERROR
at+cops=4,2,d
OK

at+cops=4,2,d02
OK
BUSY

2.14 AT+CPBS, selected phonebook memory storage

At Command	Reaction	Remark
at+cpbs=<storage>	+CPBS: <storage>[,<used>,<total>]	**<storage>** "FD" SIM fix dialling phonebook "LD" Last dialling phonebook "ME" ME phonebook "MT" ME and SIM phonebook "SM" SIM phonebook "DD" Direct Dial phonebook "RC" ME received calls list "MC" ME missed calls list

Notes:
1. The g18 needs more than 10 seconds to display the whole and right answer of AT+CPBS=? Directly after at+cpin="0000" the g18 returns with +CPBS:("FD","LD","ME","MT"), 3 seconds later the g18 returns with +CPBC:("FD","LD","ME","ME","SM"), further 5 seconds later the g18 returns with +CPBS:("FD","LD","ME","MT","SM","DD","RC","MC")
2. MC (missed calls) and RC (received calls) share the same area. They both limited to total 10 records, and they both are sorted by time stamp: 1st record in phone book is the latest received or not answered.

at+cpbs=?
+CPBS: ("FD","LD","ME","MT","SM",”DD”,"RC","MC")
OK

at+cpbs?
+CPBS: 0,0
OK

```
at+cpbs="fd"
OK

at+cpbs?
+CPBS: "FD",1,10
OK

at+cpbs="DC"
+CME ERROR: 003

at+cpbs="LD"
OK

at+cpbs?
+CPBS: "LD",10,10
OK

at+cpbs="me"
OK

at+cpbs?
+CPBS: "ME",0,100
OK

at+cpbs="MT".
OK

at+cpbs?
+CPBS: "MT",14,200
OK

at+cpbs="SM"
OK

at+cpbs?
+CPBS: "SM",14,100
OK
```

2.15 AT+CPBW, Write phonebook entry

At Command	Reaction	Remark
at+cpbw=[<index>], [,<number> [<type> [,<text>]]]	+cpbw: (list of supported <index>s),[<nlength>], (list of supported <type>s), [<tlength>]	**<index>** Location number of the phonebook **<number>** Phone number in format <type> **<type>** type of address: 129 - normal format 145 - intern. format **<text>** Name of the entry <nlength> with maximum length of <number> **<tlength>** Maximum length of <text>

Notes:

1. when creating new entry without name than the response is OK but no action done.
2. Telephone Book "MT" is a combination of "ME" and "SM". It is advised to write entries to a specific phone book (ME or SM) instead of writing to MT phone book. When writing to SM or ME phone book, g18 will validate string length for phone number and label, as defined for the specific phone book. When writing to MT phone book, g18 is not able to detect errors, if a string length less than allowed in MT phone book, but more that what defined in the specific phone book. In this case, write will not rejected, but number and text will be truncated to the limit allowed for the specific phone book.

   For example,

   ```
   at+cpbs="sm";+cpbw=?
   +CPBW: (101-220),020,(255,129,145),014          // SM phone book definitions: number
                                                  length limited to 20, text length limited to 14.

   OK
   at+cpbs="mt";+cpbw=?
   +CPBW: (001-220),032,(255,129,145),016         //  MT phone book definitions: number
                                                  length limited to 32, text length limited to 16.

   OK
   ```

   In the next statement, try to write a record to SM area in MT phone book (record 110 is in this area), with a 21 digits for phone number, and 15 digits for text. This is legal for MT phone book, and therefore no error is expected. However, since it is written to SM area, phone number is truncated to 20, and text is truncated to 14.

   ```
   at+cpbw=110,"123456789012345678901",,"123456789012345"      //  No error when
                                                  writing to MT, to a slot defined in SM phone book
   OK
   at+cpbr=110
   +CPBR: 110,"12345678901234567890",129,"12345678901234"    // Record wrriten to
                                                  phone book as defined in the definition limitation.
   ```

OK

```
at+cpbs="mt"
OK

at+cpbw=?
+CPBW: (1-200),32,(255,129,145),18
at+cmee=1
OK

at+cpbw=140,"+496113611404",145,"Raum 1004"
+CME ERROR: 003

at+cpbw=140,"496113611404",145,"Raum1004"
+CME ERROR: 003

at+cpbs="SM"
OK

at+cpbw=140,"496113611404",145,"Raum1004"
OK

at+cpbs="ME"
OK

at+cpbw=73,"491726706014,145,"eigene number"
+CME ERROR: 100

at+cpbw=73,"491726706014",145,"eigene number"
OK

at+cpbw=190,"491728788793",145,"Freundin"
+CME ERROR: 021.

at+cpbs?
+CPBS: "ME",2,100
OK

at+cpbs="MT"
OK

at+cpbw=73,"496128970912",145,"Eigene Number"
OK

at+cpbw=190,"491728788793",145,"Freundin"
OK
```

2.16 AT+CPIN, Enter pin

Command	Reaction	Remark
at+cpin=[<puk>or <pin>[<newpin>]	Enters pin or change pin number at entering pin, new pin is not required	**<puk>** PUK code for blocked phone **<pin>** Current pin **<newpin>** New pin (after changing or after entering PUK) 4 - 8 digits.

Note:

1. The following AT commands are enabled without a valid SIM: GCAP, GMI,GMR, IFC, CEER, CGMI, CGMM, CGMR, CGSN, CHUP, CIPE, CKPD, CMEE, CMER, CIP, CRC, CSQ, CR

2. when PUK is required, and only one parameter is given in +CPIN, error "PUK is required" is returned.

at+cpin="3011"
OK

at+cpin=?
OK

at+cpin?
+CPIN: READY
OK

at+cpin="3011","2811"
OK

at+cpin"1111"
ERROR

at+cpin="11111"
ERROR

at+cpin="12345"
ERROR

at+cpin="1222"
ERROR

at+cpin?
+CPIN: SIM PIN
OK

at+cpin="71388330","3011"
OK

2.17 AT+CREG, Network registration

At Command	Reaction	Remark
at+creg=<n>		**<n>** 0 disable network registration unsolicited result code
at+creg?	+creg: <n>,<stat>[,<lac>,<ci>]. OK	1 Enable network registration unsolicited result code `+CREG: <stat>`
at+creg=?	+CREG: (0,1,2)	2 enable network registration and location information unsolicited result code **<stat>** 0 Not registered 1 Registered (home network) 2 Not registered but ME search for a network 3 Registration denied 4 Unknown 5 Registered roaming **<lac>** 2 Byte location code (hex) **<ci>** 2 bytes cell ID (hex)

at+creg=?
+CREG: (000,001,002)
OK
at+creg?
+CREG: 000,001
OK

```
at+creg=2
OK
at+creg?
+CREG: 002,001,"6202","6113"
OK
at+creg=1
OK
at+creg?
+CREG: 001,001
OK
at+creg=0
OK
at+creg=2,5
ERROR

at+creg?
+CREG: 002,001,"6202","6113"
OK

at+creg=1
OK
at+creg?
+CREG: 001,001
OK
```

2.18 AT+CSTA, Select type of address

At Command	Reaction	Remark
at+csta=<type>		**<type>** number format 129 Normal
at+csta?	+csta: <type> OK	145 With international access character +
at+csta=?	+csta: (129,145)	

```
at+csta?
+CSTA: 129

OK
at+csta=145
OK
at+csta?
+CSTA: 145
```

OK
at+csta=129
OK
at+csta?
+CSTA: 129

OK

2.19 AT+CBST, Select bearer service type

At Command	Reaction	Remark
at+cbst=?	+cbst: <speed>,<name>,<ce>	**<speed>** 0 autobauding 1 300 bps (V.21) 2 1200 bps (V.22) 4 2400 bps (V.22bis) 5 2400 bps (V.26ter) 6 4800 bps (V.32) 7 9600 bps (V.32) 65 300 bps (V.110) 66 1200 bps (V.110) 68 2400 bps (V.110) 70 4800 bps (V.110) 71 9600 bps (V.110) **<name>** 0 data circuit asynchronous **<ce>** 0 transparent 1 non-transparent 2 both, transparent preferred 3 both, non-transparent preferred

at+cbst=?
+CBST: (000-002,004-007, 065,066,068,070,071), (000), (001)

OK
at+cbst?
+CBST: 007,000,001

OK
at+cbst=1,0,1

OK
at+cbst?
+CBST: 001,000,000

OK
at+cbst=7,3,4
+CME ERROR: operation not allowed
at+cbst=7,0,1
OK
at+cbst?
+CBST: 007,000,001

OK

2.20 AT+CGMI, Request manufacturer identification

At Command	Reaction	Remark
at+cmgi	+cgmi: <manufacture>	**<manufacture>** Name of the manufacture.

at+cgmi
+CGMI: “MOTOROLA”

OK

at+cgmi?
ERROR

2.21 AT+CGMM, Request model identification

At Command	Reaction	Remark
at+cgmm=	+cgmm: <model>	**<model>** Model identification

at+cgmm?
ERROR

at+cgmm=?
OK

at+cgmm
PC Card: Motorola g18

OK

2.22 AT+CGMR, Request revision identification

At Command	Reaction	Remark
at+cgmr	+cgmr: <revision>	**<revision>** Revisions number of the software Request revision identification

at+cgmr?
ERROR

at+cgmr=?
OK
at+cgmr
PC Card: g18_vE6.02.07

OK

2.23 AT+CGSN, Request product serial number identification

At Command	Reaction	Remark
at+cgsn	+cgsn <sn>	**<sn>** IMEI number

at+cgsn?
ERROR
at+cgsn=?
OK
at+cgsn
+CGSN: 447764074608839

OK

2.24 AT+CHUP, Hang up call

At Command	Reaction	Remark
at+chup=	Phone hangs up	

at+chup=?
OK
at+chup
OK
RING

at+chup?
ERROR

2.25 AT+CMGD, Delete SMS message

At Command	Reaction	Remark
at+cmgd=<index>	Delete SMS	**<index>** Position of the SMS in the storage

Note :
Delete SMS with ID=0 is not allowed.
Delete SMS with ID=75 is allowed.
Delete SMS with illegal ID or with non-existence SMS, ends with "Invalid index"

at+cmgd
ERROR
at+cmgd=?
OK
at+cmgd?
ERROR
at+cmgl=?
+CMGL: (000-004)

OK
at+cmgf=0
OK
at+cmgl
+CMGL: 001,000,023
07919471227230330408831027492204F0000099309261451480 04C2A2F308
OK

at+cmgd=1
OK
at+cmgf=0
OK
at+cmgl
OK

2.26 AT+CMGF, Message Format

At Command	Reaction	Remark
at+cmgf= <mode>	+cmgf: <mode>	**<mode>** 0 PDU mode 1 Text mode (not supported)

at+cmgf?
+CMGF: 000

OK
at+cmgf=?
+CMGF: (000)

OK
at+cmgf=1
+CME ERROR: operation not allowed

2.27 AT+CMGL, List messages

At Command	Reaction	Remark
at+cmgl=<stat>	List SMS messages with a selected status	**<stat>** 0 "REC UNREAD" received unread message (i.e. new message) 1 "REC READ" received read message 2 "STO UNSENT" stored unsent message 3 "STO SENT" stored sent message 4 "ALL" all messages

Note:
1. Use of any valid value of +CMGL parameter (0-4) performs list of all messages. The selection list of messages is valid only in SW version above E6.01.10

at+cmgl=?
+CMGL: (000-004)

OK
at+cmgf=0
OK
at+cmgl
+CMGL: 001,000,023

07919471227230330408831027492204F0000099309261451480O4C2A2F308
OK.

Note:
you should wait to OK before sending new AT command.

2.28 AT+CMGR, Read messages

At Command	Reaction	Remark
at+cmgr=<index>	Read SMS Message +CMS ERROR: <err>	**<index>** Location of the SMS in the storage

at+cmgr=2
+CMGR: 001,,023
07919471227230330408831027492204F0000099309271909480O4C2A2F308
OK

2.29 AT+CPAS, Phone activity status

AT Command	Reaction	Remark
AT+CPAS	+CPAS: <pas> +CME ERROR: <err>	**<pas>** 0 Ready 1 Unavailable 2 Unknown 3 Ringing (MT calls) 4 Call in progress 5 Asleep
AT+CPAS=?	+CPAS: (list of supported <pas>s) +CME ERROR: <err>	

at+CPAS
+CPAS: 000

OK
at+CPAS=?
+CPAS: (000-005)

OK

2.30 AT+CPBR, Read phonebook entries

AT Command	Reaction	Remark
at+cpbr= <index>	+cpbr: <index>,<number>,<type>,<text>	**<index>** Location number in the storage **<number>** Phone number in the <type> format **<type>** 129 Normal 145 With international access character + **<text>** Name of the entry

at+cpbr=?
+CPBR: (1-200),32,18

OK
at+cpbr=73
+CPBR: 73,"+496128970912",145,"Eigene Number"

OK
at+cpbr=10
OK
at+cpbr=100
OK
at+cpbr=101
+CPBR: 101,"+491721212",145,"D2-Kundenbetreuung"

OK
at+cpbr=74.
+CPBR: 74,"+496113611400",145,"test"

OK
at+cpbr=32
OK
at+cpbr=112
OK
at+cpbr=124
+CPBR: 124,"+4917222333",145,"D2-Hotelservice"

OK

2.31 AT+CPMS, Preferred message storage

At Command	Reaction	Remark
at+cpms=<mem1>, <mem2>	+CPMS: <used1>,<total1>,<used2>,<total>	**<mem>** Memory storage **<used>** Used memory in the storage **<total>** Total memory in the storage

at+cpms=?
+CPMS: ("SM"),("SM")

OK
at+cpms?
+CPMS: "SM",005,020,"SM",005,020

OK
a
OK
at+cpms="SM"
+CPMS: 005,020,005,020

OK
at+cpms?
+CPMS: "SM",005,020,"SM",005,020

OK

2.32 AT+CSCA, Service center address

At Command	Reaction	Remark
at+csca= <sca>,<type>	+csca: <sca>,<type>	**<sca>** Service center number **<type>** format of the number 129 = normal 145= with international access character +

+csca?
+CMS ERROR: SMSC address unknown

at+csca=?.
OK
at+csca="491722270333",145
ERROR
at+csca?
+CSCA: "+491722270333",145

OK

2.33 AT+CSCS, Select TE character set

At Command	Reaction	Remark
at+cscs= [<chset>	+cscs: <chset>	**<chset>** GSM GSM alphabet IRA International alphabet

at+cscs=?
+CSCS: ("GSM", "IRA")

OK
at+cscs?
+CSCS: "IRA"

OK
at+cscs="gsm"
OK
at+cscs?
+CSCS: "GSM"

OK
at+cscs="IRA"
OK
at+cscs?
+CSCS: ("IRA")

OK

2.34 AT+CSMS, Select message service

AT Command	Reaction	Remark
at+csms	select message service	
at+csms =<service>	+CSMS: <mt>, <mo>, <bm> +CMS ERROR: <err>	**<Service>** 0 GSM 03.40 and 03.41.The Syntax of SMS AT commands is compatible with GSM 07.05 phase2 version 4.7.0. Phase 2+ features which don't require new command syntax maybe supported. **<mt>,< mo>,< bm>** 0 Type not supported 1 Type supported
at+csms?	+CSMS: <service>, <mt>, <mo>, <bm>	
at+csms=?	+CSMS: (list of supported <service>)	

at+csms
ERROR
at+csms=?
+CSMS: (000)

OK
at+csms?
+CSMS: 000,001,001,001

OK
at+csms=0
+CSMS: 001,001,001

OK

2.35 AT+CSQ, Signal quality

At Command	Reaction	Remark
at+csq	+CSQ: <rssi>,<ber>	<**rssi**> 0 - 0 Bars 1 - 1 Bar 10 - 2 Bars 20 - 3 Bars 30 - 4 Bars 31 - 5 Bars <**ber**> (in percent) 99 Not known or detectable

at+csq
+CSQ: 030 ,099
OK

at+CSQ=?
+CSQ: (000-031,099), (099) // Note: Ber information not supported

2.36 AT+CEER, Extended error report

Command	Response
at+CEER	+CEER: <report>
at+CEER=?	OK
At+CEER?	Error

at+ceer=?
OK
at+ceer?
ERROR
at+ceer
+CEER:"No information available"

OK

2.37 AT+CKPD

Command	Possible response(s)	Remark
at+CKPD=<Keys>[,<time>[,<pause>]]	OK +CME ERROR: <err>	<**Keys**> # hash (number sign) * star (*) 0…9 number keys : escape character for manufacturer specific keys ; escape character for string entering < left arrow > right arrow C/c clear display (C/CLR) D/d volume down E/e connection end (END) L/l phone lock (LOCK) M/m menu (MENU) Q/q quiet/mute (MUTE) S/s connection start (SEND) T/t store/memory (STO/M/M+) U/u volume up V/v don arrow Y/y delete last character (C) :0 smart button. (Colon followed by zero) :A voice annotator ^ up arrow
		<**time**>, <**pause**>: 0…255 0…25.5 seconds (default values are manufacturer specific, but should be so long that a normal ME can handle key strokes correctly)

at+ckpd=?
OK
at+ckpd=”M”
OK

at+ckpd=”>”
OK

2.38 AT+FCLASS, Select mode

Command	Response
at+FCLASS=<n>	If n= 0 or n=1 OK , else return ERROR
at+FCLASS?	<n>
at+FCLASS=?	FCLASS: (list of supported <n>s)

AT+FCLASS=?
FCLASS: 0, 1

OK
AT+FCLASS?
+FCLASS: 0

OK

2.39 AT+GCAP, Request complete capabilities list

Command	Response
at+GCAP	GCAP: (list of capabilities)

AT+GCAP
+GCAP: +FCLASS

OK
AT+GCAP=?
ERROR

AT+GCAP
ERROR

2.40 AT+CMOD, Call mode

Command	Possible response(s)	Remark
+CMOD=[<mode>]		<**mode**> 0 single mode 1 alternating voice/fax (teleservice 61)
+CMOD?	+CMOD: <mode>	
+CMOD=?	+CMOD: (list of supported <mode>s)	

AT+CMOD =?
+CMOD: (000, 001)

OK
AT+CMOD?
+CMOD: 000

OK
AT+CMOD=1
OK

2.41 AT+CRLP, Radio link protocol

Command	Possible response(s)	Remarks
+CRLP= [<iws>[,<mws>[,<T1>[,<N2>]]]]		<iws>, <mws>, <T1>, <N2>: IWF to MS window size (default 61), MS to IWF window size (default 61), acknowledgement timer T1 (default 48), and retransmission attempts N2 (default 6) in integer format (refer GSM 04.22 [18] subclause 5.4.3)
+CRLP?	+CRLP= <iws>,<mws>,<T1>,<N2>	
+CRLP=?	+CRLP= (list of supported <iws>s), (list of supported <mws>s), (list of supported <T1>s), (list of supported <N2>s)	

AT+CRLP=?
+CRLP: (010-061),(010-061),(048-255),(006-010)
OK
AT+CRLP?
+CRLP: 061, 061, 048, 006

OK

2.42 AT+CR, Service reporting control

Command	Possible response(s)	Remarks
+CR= [<mode>]		<**mode**> 0 disables reporting 1 enables reporting <**serv**> ASYNC asynchronous transparent SYNC asynchronous transparent REL ASYNC asynchronous non-transparent REL SYNC asynchronous non-transparent
+CR?	+CR: <mode>	
+CR=?	+CR: (list of supported<mode>s)	

AT+CR
ERROR

AT+CR=?
+CR: (000,001)

OK
AT+CR?
+CR: 000

OK

2.43 AT+CRC, Cellular result codes

Command	Possible response(s)	Remark
+CRC= [<mode>]		<**mode**>: 0 disables extended format 1 enables extended format <**type**>: ASYNC asynchronous transparent SYNC synchronous transparent REL ASYNC asynchronous non-transparent REL SYNC synchronous non-transparent FAX facsimile (TS 62) VOICE normal voice (TS 11) VOICE/*XXX* voice followed by data (BS 81)(*XXX* is ASYNC, SYNC, REL ASYNC or REL SYNC) ALT VOICE / *XXX* alternating voice / data, voice first (BS 61) ALT *XXX* / VOICE alternating voice / data, datafirst (BS 61) ALT VOICE / FAX alternating voice / fax, voice first (TS 61) ALT FAX / VOICE alternating voice / fax, FAX first (TS 61)
+CRC?	+CRC: <mode>	
+CRC?	+CRC: (list of supported <mode>s)	

AT+CRC?
+CRC:000

OK
AT+CRC
ERROR

AT+CRC=?
+CRC: (000,001)

OK

2.44 AT+CNMI, New message indications to TE+CNMI

Command	Possible response(s)	Remark
+CNMI=[<mode>[,<mt>[,<bm>[,<ds>[,<bfr>]]]]]	+CMS ERROR: <err>	**<mode>** 0 Buffer unsolicited result codes in the TA. If TA result code buffer is full, indications can be buffered in some other place or the oldest indications may be discarded and replaced with the new received indications. **<mt>** 0 No SMS DELIVER indications are routed to the TE route message to TE 1 Indication of memory location is routed to TE 2 SMS DELIVERs are routed directly to TE. **See note below** **<bm>** 0 No CBM indications are routed to TE 2 New CBMs are routed directly to TE **<ds>** 0 No SMS-STATUS-REPORTs are routed to the TE 1 SMS-STATUS-REPORTs are routed to the TE using unsolicited result code: +cds: <length><cr><lf><pdu> **<bfr>** 0 TA buffer of unsolicited result codes defined within this command is flushed to TE when <mode> 1…3 is entered (OK response shall be given before flushing the codes).
+CNMI?	+CNMI: <mode>,<mt>,<bm>,<ds>,<bfr>	
+CNMI=?	+CNMI: (list of supported <mode>s), (list of supported <mt>s), (list of supported <bm>s), (list of supported <ds>s), (list of supported <bfr>s)	

Note :
After automatic SMS/CBM message transfer to DTE (mt=2 and/or bm=2), g18 waits for a response +CNMA from the DTE (within one minute). If DTE does not respond within this time, or another message arrives from network, g18 will save message in SIM, will exit from SMS mode, and all CNMI parameters will be set to zero.

Examples :

at+cmgl
OK No messages on SIM
at+cnmi=0,2,2,1

OK
at+cnmi?
+CNMI: 000,002,002,001,000

OK

+CMT: 026 // 1st message indication
07917952140230F2040B917952545608F50000101003417170000 7B12915D49C1E01
at+cnma // Response of the DTE
OK

+CMT: 036 // 2nd message indication
07917952140230F2040B917952545608F50000101003418380001 3C7E793086A3EA5
CEA4F308A23E
41D96715
at+cnma // Response of the DTE
OK
+CMT: 026 // 3rd message indication
07917952140230F2040B917952545608F50000101003410203000 7332911D49C1E01
at+cnmi?
+CNMI: 000,000,000,000,000 // CNMI parameters changed since the
// DTE did not response with +CNMA

OK
at+cmgl
+CMGL: 001,000,,026 // The 3rd message stored in the SIM
07917952140230F2040B917952545608F50000101003410203000 7332911D49C1E01
OK
at+cmgl
+CMGL: 001,001,,026
07917952140230F2040B917952545608F50000101003410203000 7332911D49C1E01
+CMGL: 002,000,,029 // New message stored also into the SIM
07917952140230F2040B917952545608F50000101003414240000 BCEE215D42C4EA7
C16311
OK
at+cnmi=0,2,2,1 // Setting CNMI parameters to receive again new messages on DTE
OK

at+cnmi=?
+CNMI: (000),(000-002),(000,002),(000,001),(000)

OK
at+cmni?
ERROR
at+cnmi=0,2,2,1,0
OK

2.45 AT+CMEC, Mobile Equipment control mode

Command	Possible response(s)	Remarks
+CMEC= [<keyp>[,<disp>[,<ind>]]]	+CMEC ERROR: <err>	**<keyp>** 0 ME can be operated only through its keypad 2 ME can be operated from both ME keypad and TE **<disp>** 0 Only ME can write to its display **<ind>** 0 Only ME can set the status of its indications
+CMEC?	+CMEC: <keyp>,<disp>,<ind>	
+CMEC=?	+CMEC: (list of supported <keyp>s), (list of supported <disp>s), (list of supported <ind>s)	

AT+CMEC?
+CMEC: 02, 00, 00

OK
AT+CMEC=?
+CMEC: (00,02), (00), (00)

OK
AT+CMEC=2, 0, 0
OK

2.46 AT+CMER, Mobile Equipment event reporting

Command	Possible response(s)	Remarks
+CMER= [<mode>[,<keyp>[, <disp>[,<bfr>]]]]]	+CME ERROR: <err>	**<mode>:** 0 Buffer unsolicited result codes in the TA; if TA result code buffer is full, codes can be buffered in some other place or the oldest ones can discarded **<keyp>:** 0 No keypad event reporting **<disp>:** 0 No display event reporting 1 Display event reporting +CDEV: <Upper corner>, <text>, <Lower corner>. The display height is 54 pixels: 0-53. The upper corner refers to the starting hight point and the lower corner refers to the bottom right ending point. and <text> is the new value of text element. **<ind>** 0 No indicator event reporting 1 Indicator event +CIEV: <ind>, <value>. <ind> indicates the indicator order number and <value> is the new value of indicator. +ciev:00, 00 Battery indicator (0-3) +ciev:01, xx Signal bars # (xx=1-5) +ciev:02, xx Service availability 0/1 +ciev:03, xx SMS envelope ind (0/1) +ciev:04, xx Call in progress (0/1) +ciev:05, xx Roaming indicator (0/1) +ciev:06, xx Sim pin1 requested (0/1) +ciev:07, x Sim SMS full (0/1) +ciev:08, x GPRS coverage (0/1) **<bfr>** 0 TA buffer of unsolicited result codes defined within this command is cleared when <mode> 1…3 is entered
+CMER?	+CMER: <mode>, <keyp>, <disp>, <ind>, <bfr>	
+CMER=?	+CMER: (list of supported <mode>s), (list of supported <keyp>s), (list of supported <disp>s), (list of supported <ind>s), (list of supported <bfr>s)	

AT+CMER=?
+CMER: (00), (00), (00,01), (00,01), (00)

OK
AT+CMER?
+CMER: 00, 00, 00, 00, 00

OK
AT+CMER=0, 0, 1, 0, 0
OK

2.47 AT+CPBF, Find phonebook entries

Command	Possible response(s)	Remark
+CPBF=<findtext>	+CPBF: <index1>, <number>, <type>, <text> [[…] <CR><LF>+CBPF: <index2>, <number>, <type>, <text>] +CME ERROR: <err>	**<index1>, <index2>** integer type values in the range of location numbers of phone book memory **<number>** string type phone number of format <type> **<type>** type of address octet in integer format (refer GSM 04.08 [8] subclause 10.5.4.7) **<find text>, <text>:** string type field of maximum length **<tlength>** character set as specified by command Select TE Character Set +CSCS **<nlength>** integer type value indicating the maximum length of field <number> **<tlength>** integer type value indicating the maximum length of field <text>
+CPBF=?	+CPBF: <nlength>, <tlength> +CME ERROR: <err>	

at+cpbs =“SM”

OK

at+cpbf =?
+CPBF: 020, 014

OK
at+cpbf =”RON”
+CPBF: 105, “035655555”, 129, “RON”

+CPBF: 106, “054564254”, 129, “RONEN”

OK
at+cpbf =”ron”
OK
at + cpbf =” “ /list of all entries
+CPBF: 101, “06251455”, 129, “AVI”

+CPBF: 102, “052646651”, 129, “DAVID”

+CPBF: 103, “04621515”, 129, “BEN”

+CPBF: 104, “02665111”, 129, “CHRIS”

+CPBF: 105, “03565555”, 129, “RON”

+CPBF: 106, “054564254”, 129, “RONEN”

OK

2.48 AT+CESP , Enter SMS block mode

Command	Possible response(s)	Remark
at+cesp at+cesp=?	OK	prior to entering the block mode

at+cesp
OK

2.49 AT+CMGW ,Write message

Command	Possible response(s)	Remark
At+cmgw=<nn>	+cmgw: <index>	<**nn**> The message's length <**index**> location of the stored message is returned

at+cmgw=24
>07917952140230F2040B917952545630F200000070528141630005A060B10902
<ctr/Z>
+CMGW: 001
OK

2.50 AT+CTFR1, divert an Incoming call to the voice mail

Command	Possible response(s)	Remark
AT+CTFR1	+CME ERROR: <err>	If there is no waiting call in progress

RING
at+ctfr1
OK

at+ctfr1 // When there isn't call received
+CME ERROR: "operation not allowed"

2.51 AT+CNMA, DTE confirms previous message

Command	Possible response(s)	Remark
AT+CNMA	OK	Must be send within 60 seconds from the arrival of the message to the DTE, otherwise the message will be stored on SIM card and the parameters of the CNMI command will be set to Zero.

Note: See (2.1. 44) for examples

2.52 AT+CBAND, change band

Command	Possible response(s)	Remark
AT+CBAND = N	OK ERROR	Wait for power cycle to apply the change. Not valid value **N** 3 – For 1900Mhz **4** - For 900/1800Mhz

at+cmee=2
OK
at+cband?
+CBAND: 4

OK
at+cpin?
+CPIN: READY

OK
at+cband=3
OK // g18 waits for power cycle
at+cpin?
+CME ERROR: "no network service"

2.53 AT+CBAUD, set the baud rate

Command	Possible response(s)	Remark
AT+CBAUD=<n> OR AT+CBAUD=<rate>	OK ERROR	**<n> <rate>** 0 - 300 1 - 600 2 – 1200 3 – 2400 4 – 4800 5 – 9600 6 – 19200 7 – 38400 8 – 57600 **9** - Auto baud rate detection

Notes:

1. For example, AT+CBAUD=8 is equivalent to AT+CBAUD=57600.
2. Using AT+CBAUD=<baud> with <baud> value other than 9, will disable auto baud rate detection feature.

2.54 AT+CGPRS, GPRS coverage

Command	Possible response(s)	Remark
AT+CGPRS AT+CGPRS?	+CGPRS: <mode>, OK ERROR	**<mode>** **0 - No** GPRS coverage **1 -** GPRS coverage

AT+CGPRS
+CGPRS: 0

OK
AT+CGPRS?
+CGPRS: 0

OK
AT+CGPRS=1
+CME ERROR: "operation not allowed"

Note: This command without attachment will return always zero.

2.55 AT+CGPADDR, Show PDP address

Command	Possible response(s)
+CGPADDR=[<c id> [,<cid> [,…]]] AT+CGPADDR=?	+CGPADDR: <cid>,<PDP_addr> [<CR><LF>+CGPADDR: <cid>,<PDP_addr>] +CGPADDR:(list of defined <cid>s)

AT+CGPADDR=?

+CGPADDR: (1,2,3)

OK

2.56 AT+CGCLASS, GPRS MS class

Command	Possible response(s)
AT+ +CGCLASS= [<class>]	OK ERROR
AT +CGCLASS?	+CGCLASS: <class>
AT +CGCLASS=?	+CGCLASS: (list of supported <class>s)

AT+CGCLASS=?

+CGCLASS: (B)

OK
AT+CGCLASS="B"

OK

AT+CGCLASS="A"
ERROR

2.57 AT+CGDCONT, define PDP context

Command	Possible response(s)
+CGDCONT=[<cid> [,<PDP_type> [,<APN> [,<PDP_addr> [,<d_comp> [,<h_comp> [,<pd1> [,…[,pdN]]]]]]]]	OK ERROR
AT+CGDCONT?	+CGDCONT: <cid>, <PDP_type>, <APN>,<PDP_addr>, <data_comp>, <head_comp>[,<pd1>[,…[,pdN]]] [<CR><LF>+CGDCONT: <cid>, <PDP_type>, <APN>,<PDP_addr>, <data_comp>, <head_comp>[,<pd1>[,…[,pdN]]]
AT+CGDCONT=?	+CGDCONT: (range of supported <cid>s), <PDP_type>,,,(list of supported <d_comp>s), (list of supported <h_comp>s)[,(list of supported <pd1>s)[,…[,(list of supported <pdN>s)]]] [<CR><LF>+CGDCONT: (range of supported <cid>s), <PDP_type>,,,(list of supported <d_comp>s), (list of supported <h_comp>s)[,(list of supported <pd1>s)[,…[,(list of supported <pdN>s)]]]

AT+CGDCONT=?

+CGDCONT: (1-3),("IP"),,,(0,1),(0,1)

OK

AT+CGDCONT?

+CGDCONT: 1,"IP","","0.0.0.0",0,0
+CGDCONT: 2,"IP","","0.0.0.0",0,0
+CGDCONT: 3,"IP","","0.0.0.0",0,0

OK
AT+CGDCONT=1,"IP","RTY","123.32.45.9"

OK
AT+CGDCONT=4 // Its only allowed to set up to 3 PDP contexts

ERROR

2.58 AT+CGQMIN, Quality of Service Provider

Command	Possible response(s)
+CGQMIN=[<cid> [,<precedence > [,<delay> [,<reliability.> [,<peak> [,<mean>]]]]]]	OK ERROR
+CGQMIN?	+CGQMIN: <cid>, <precedence >, <delay>, <reliability>, <peak>, <mean> [<CR><LF>+CGQMIN: <cid>, <precedence >, <delay>, <reliability.>, <peak>, <mean> […]]
AT +CGQMIN=?	+CGQMIN: <PDP_type>, (list of supported <precedence>s), (list of supported <delay>s), (list of supported <reliability>s) , (list of supported <peak>s), (list of supported <mean>s) [<CR><LF>+CGQMIN: <PDP_type>, (list of supported <precedence>s), (list of supported <delay>s), (list of supported <reliability>s) , (list of supported <peak>s), (list of supported <mean>s)

AT+CGQMIN=?
+CGQMIN: (1-3),(0-3),(0-4),(0-5),(0-9),(0-18,31)

OK
AT+CGQMIN?

+CGQMIN: 1,2,4,3,9,10
+CGQMIN: 2,2,4,3,9,10
+CGQMIN: 3,2,4,3,9,10

OK

For more details in Quality of Service refer to ETSI specification GSM 03.60.

2.59 AT+CGACT, PDP context activation/deactivation request

Command	Possible response(s)
+CGACT=[<state> [,<cid>[,<cid>[,…]]]]	OK ERROR
+CGACT?	+CGACT: <cid>, <state> [<CR><LF>+CGACT: <cid>, <state>
AT +CGACT=?	+CGACT: (list of supported <state>s)

AT+CGACT=?

+CGATT: (0, 1)

OK

AT+CGACT?

+CGACT: 1,0
+CGACT: 2,0
+CGACT: 3,0

OK
AT+CGACT=1
ERROR // GPRS network not present .

In some GPRS networks (for example - Germany) +CGACT is not supported. ATD*99# command can be used to get a connection.

2.60 AT+CGATT, GPRS attach/detach request

Command	Possible response(s)
AT+CGATT= [<state>]	OK ERROR
AT+CGATT?	+CGATT: <state>
AT+CGATT=?	+CGATT: (list of supported <state>s)

AT+CGATT=?

+CGATT: (0, 1)

OK
AT+CGATT?

+CGATT: 0

OK

AT+CGATT=1
ERROR
AT+CGATT=0

OK

2.61 AT+CGQREQ, define/modify/remove a requested Quality of Service Profile

Command	Possible response(s)
+CGQREQ=[<cid> [,<precedence > [,<delay>[,<reliability.> [,<peak> [,<mean>]]]]]]	OK ERROR
+CGQREQ?	+CGQREQ: <cid>, <precedence >, <delay>, <reliability>, <peak>, <mean>
+CGQREQ=?	+CGQREQ: <PDP_type>, (list of supported <precedence>s), (list of supported <delay>s), (list of supported <reliability>s) , (list of supported <peak>s), (list of supported <mean>s)

AT+CGQREQ=?
+ CGQREQ: (1-3),(0-3),(0-4),(0-5),(0-9),(0-18,31)

OK
AT+CGQREQ?
+CGQREQ: 1,2,4,3,9,10

+CGQREQ: 2,2,4,3,9,10

+CGQREQ: 3,2,4,3,9,10

OK

At+CGQREQ=1,0,,0,0,0
+CGQREQ: 1,0,4,0,0,0
+CGQREQ: 2,2,4,3,9,10
+CGQREQ: 3,2,4,3,9,10

OK

2.62 AT+CIMI, Request international mobile subscriber identity (IMEI)

Command	Possible response(s)	Remark
AT+CIMI	OK ERROR	<IMSI> *+CME ERROR: <err>*

AT+CIMI=?
OK

2.63 AT+CRSM, Restricted SIM access

Command	Possible response(s)	Remark
AT+CRSM=<command>[,<fileid>	OK	Only command 176 only is supported. +CRSM: <sw1>,<sw2>[,<response>]
	ERROR	*+CME ERROR: <err>*
+CRSM=?	CRSM: (176), (197, 214, 242, 243)	<fileid>: 197 IMSI 214 GID1 242 ICC ID 243 GID2 **<sw1>, <sw2>:Reason** **0 0** Success **0 1** SEEM Not Allowed, SIM card removed or no such element. **0 2** Bad Record Number, record number is out of valid range **0 3** Bad PIN, user has entered an incorrect PIN code **0 4** Other Technical Problem, some SIM card malfunction **0 5** Unavailable, data is temporarily unavailable (initializing) **255 253** Not Allowed, call processor is still initializing **255 254** Bad Device, call processor has internal error **255 255** Locked, phone is locked by user

	<response>: response of a successful completion of the command previously issued (hexa-decimal character uppercase format). The requested data will be returned.

AT+CRSM=?

CRSM: (176),(197,214,242,243)
OK
AT+CRSM=176,214

CRSM: 0,0,FFFFFFFFFFFFFFFFFF00 0000000000000000

OK

2.64 AT+CPOL, Preferred operator list

Command	Possible response(s)	Remark
AT+CPOL=[<index>][,<format>[,<oper>]]	*+CME ERROR: <err>*	**<indexn>:** integer type; the order number of operator in the SIM preferred operator list **<format> of <oper>** 0 long format alphanumeric 1 short format alphanumeric 2 numeric **<opern>:** string type; <format> indicates if the format is alphanumeric or numeric
AT+CPOL?	+CPOL: <index1>,<format>,<oper1> [<CR><LF>+CPOL: <index2>,<format>,<oper2> [...]] *+CME ERROR: <err>*	
AT+CPOL=?	+CPOL: (list of supported <index>s),(list of supported <format>s)	

AT+CPOL =?

+CPOL: (1-32),(0-2)

OK
AT+CPOL ?

+CPOL: 001, 002, "425-01"
+CPOL:00 2, 002, "250-99"

OK
AT+CPOL =1

OK
AT+CPOL =1

+CME ERROR: Not found // Index "1" is emptied before test

2.65 AT+CIPE, ENABLE +CIP AT command

Command	Possible response(s)	Remark
+CIPE=<mode>	OK +CME ERROR: <err>	**<mode>** 0 – Disable +CIP command 1 – Enable +CIP command
+CIPE?	+CIPE: <mode> OK	
+CIPE=?	+CIPE: <list of supported modes> OK	

AT+CIPE=1
OK
AT+CIPE?
+CIPE: 1

OK
AT+CIPE=?
+CIPE: (0, 1)

OK

2.66 AT+CIP, IP primitive over AT command

Command	Possible response(s)	Remark
+CIP=<Data length>,<Prim_Id>,<Sub_addr> ,<Data>	+CIP: <Data length>, <Prim id Cnf/Ind>, <Data> OK +CME ERROR: <err>	Data length (characters) – In decimal Prim_Id - in hex (2 bytes) Sub_addr (Destination) - in hex (2 bytes) Data - in hex Note : 2 characters in 1 byte

at+cip=8,a842,0020,00010001
+CIP: 38,a844,000109303335363834313318105726F6E6974

OK

2.67 AT+CRTT, Ring Tone Selection

Command	Possible response(s)	Remark
+CRTT= <RingTypeNumber>,<operation>	OK ERROR	**<RingTypeNumber>** 0 - Standard 1 -British 2 - French 3 - German 4 - Bravo 5 – 3 Tone 6 - Siren 7 - Quick 8 - 1 Ring 9 – High 10 – Music **<Operation>** 0 - Play 1- Set
+CRTT?	+CRTT: <RingTypeNumber> OK	

+CRTT=?	+CRTT: <list of supported tone types numbers>, <list of supported operations> OK

AT+CRTT=?
+CRTT: (0-10), (0,1)

OK
AT+CRTT=4, 1

OK
AT+CRTT?
+CRTT: 4

OK

2.68 AT+CPWD, Change password

Command	Possible response(s)	Remark
+CPWD=<fac>,<oldpwd>,<newpwd>	+CME ERROR: <err>	**<fac>** string type; facility (upper / lower case acceptable) CS Control Surface (keypad) SC SIM card AO Barr all outgoing calls OI Barr outgoing international calls OX Barr outgoing international calls except to Home country AI Barr all incoming calls IR Barr incoming calls when roaming outside Home country AB All Barring Services AG All Outgoing Barring Services AC All Incoming Barring Services FD SIM fixed dialling feature P2 SIM PIN2 **<oldpwd>, <newpwd>:** string type; **<oldpwd>** shall be the same as password specified for the facility from the ME user interface or with command Change Password +CPWD and <newpwd> is the new password; maximum length of password can be determined with <pwdlength> **<pwdlength>:** integer type; maximum length of the password for the facility
+CPWD=?	+CPWD: list of supported (<fac>,<pwdlength>)s +CME ERROR: <err>	

2.69 Fax AT Commands

Command	Function	Remark
"FCLASS"	Select Mode	0 – data 1 – fax 2 -fax for manufacturer specific 8 - voice
"FAE"	fax_auto_answer	Class 1
"FRH"	fax_receive_hdlc_data	Class 1
"FRM"	fax_receive_data	Class 1
"FRS"	fax_receive_silence	Class 1
"FTH"	fax_transmit_hdlc_data	Class 1
"FTM"	fax_transmit_data	Class 1
"FTS"	fax_transmit_silence	Class 1

2.70 AT+MTDTR, DTR line test command

Command	Possible response(s)	Remark
AT+MTDTR	Returns 1 when DTR is active and 0 when DTR is not active	
AT+MTDTR=?	OK	
AT+MTDTR?	Returns 1 when DTR is active and 0 when DTR is not active	

Note: The command is acceptable even when SIM card is missing.

2.71 AT+MTCTS, CTS line test command

Command	Possible response(s)	Remark
AT+MTCTS		This command will deactivate CTS,Wait about 1 second and then activate CTS.
AT+MTCTS=?	OK	

2.72 AT+MCWAKE, DTE Wake line control command

Command	Possible response(s)	Remark
AT+MCWAKE= <Mode>		**<Mode>** 0 For send no indication, 1 Send indication when GPRS coverage goes to OFF 2 Send indication when GPRS coverage goes to ON (default
AT+MCWAKE=?	+MCWAKE: (0, 1, 2)	
AT+MCWAKE?	+MCWAKE: <Mode>	

2.73 AT+CMSS, Send Message from Storage

Command	Possible response(s)	Remark
AT+CMSS=<index>[,<da>[,<toda>]]	**if text mode (+CMGF=1) and sending successful:** +CMSS: <mr>[,<scts>] **if sending fails:** +CMS ERROR: <err>	
AT+CMSS=?		

2.74 AT+MMGL, List of messages

Command	Possible response(s)
+MMGL[=<stat>]	**if PDU mode (+CMGF=0) and command successful:** +MMGL: <index>,<stat>,[<alpha>],<length><CR><LF><pdu> [<CR><LF>+MMGL:<index>,<stat>,[<alpha>],<length><CR><LF><pdu> [...]] **otherwise:** +CMS ERROR: <err>
+MMGL=?	+MMGL: (list of supported <stat>s)

Note:
1. This new AT Command will returns SMS Message list without change the message status from unread to read. It will be used just like +CMGL
2. This command supported in SW version above E6.01.10

2.75 AT+MMGR, List of messages

Command	Possible response(s)
+MMGR=<index>	**if PDU mode (+CMGF=0) and command successful:** +MMGR: <stat>,[<alpha>],<length><CR><LF><pdu> **otherwise:** +CMS ERROR: <err>
+MMGR=?	OK

Note:
1. This new AT Command will returns SMS Message without change the message status from unread to read. It will be used just like +CMGR.
2. This command supported in SW version above E6.01.10

2.76 AT+MMGA , Change message attribute

Command	Possible response(s)	
+MMGA = <index>, <attribute>	OK +CME ERROR: <err>	<index> An integer number between 1 – 75 <attribute> 0: <received-unread> 1: <received-read>
+MMGA =?	+MMGA: (001 – 075) , (000-001) OK +CME ERROR: <err>.	

Note:
1. This command supported in SW version above E6.01.10
2. SMS attribute can be: received-unread, received-read, stored-sent, and stored-unsent.
   Since there new AT Commands: MMGR & MMGL that return the message without change its attribute from received-unread to received-read, this set command can be used to change the specific message attribute from received-unread to received-read and contrarily.
3. Test command returns the whole available <index>s and <attribute>s, supported by this command.

Annex D g18 Evaluation Board

The EV board was design as a tool to operate the g18 and give an example of the different drivers/connections available. It can give an idea of how to work with the g18 in the different options.

There are two versions of the EV board released to the field - Issue P4 and Issue P5
Both of them have the same functionality but the Issue P5 board contain an additional D-sub connector for GPS connectivity.

Note: EV boards versions P4 and P5 can be used as a test tool for D10, D15 and g18.
For g18 there is need for a retrofit kit (FTN8105A) in order to make the LED's to operate in 3V logic. (D10/D15 are 5V logic).

EV Board Issue P4

To illustrate the connectivity options see the follow figure:

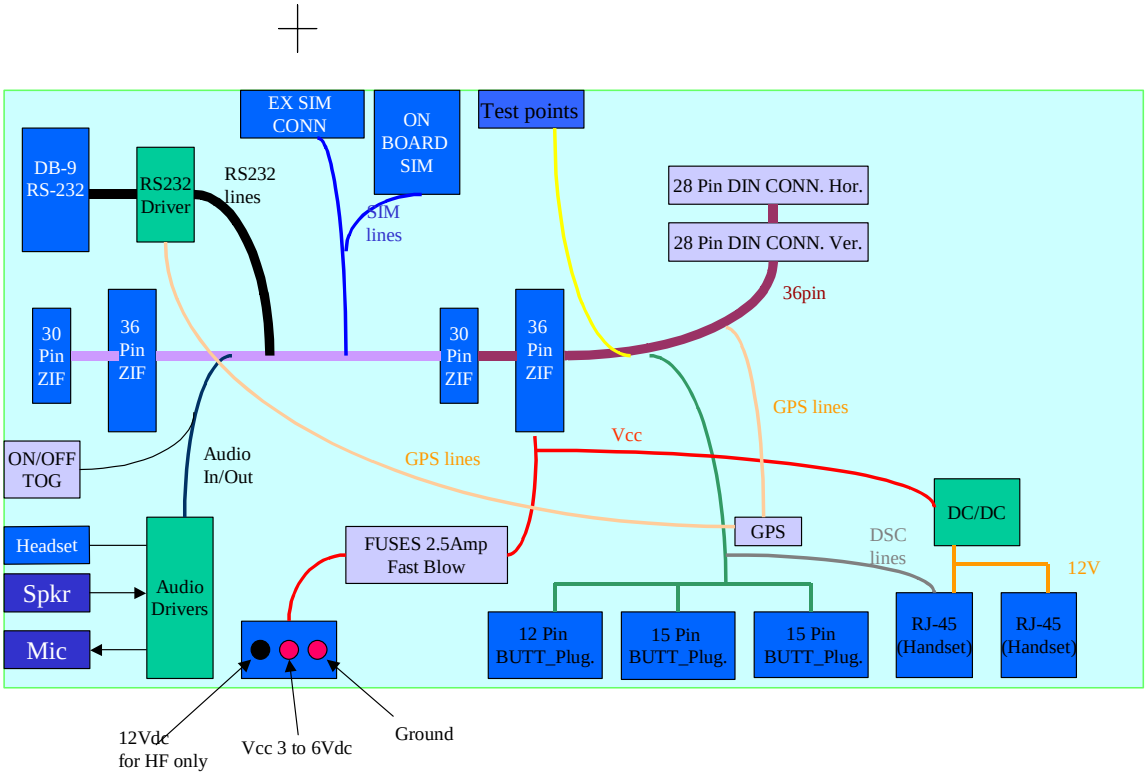


Figure 53– EV board P4

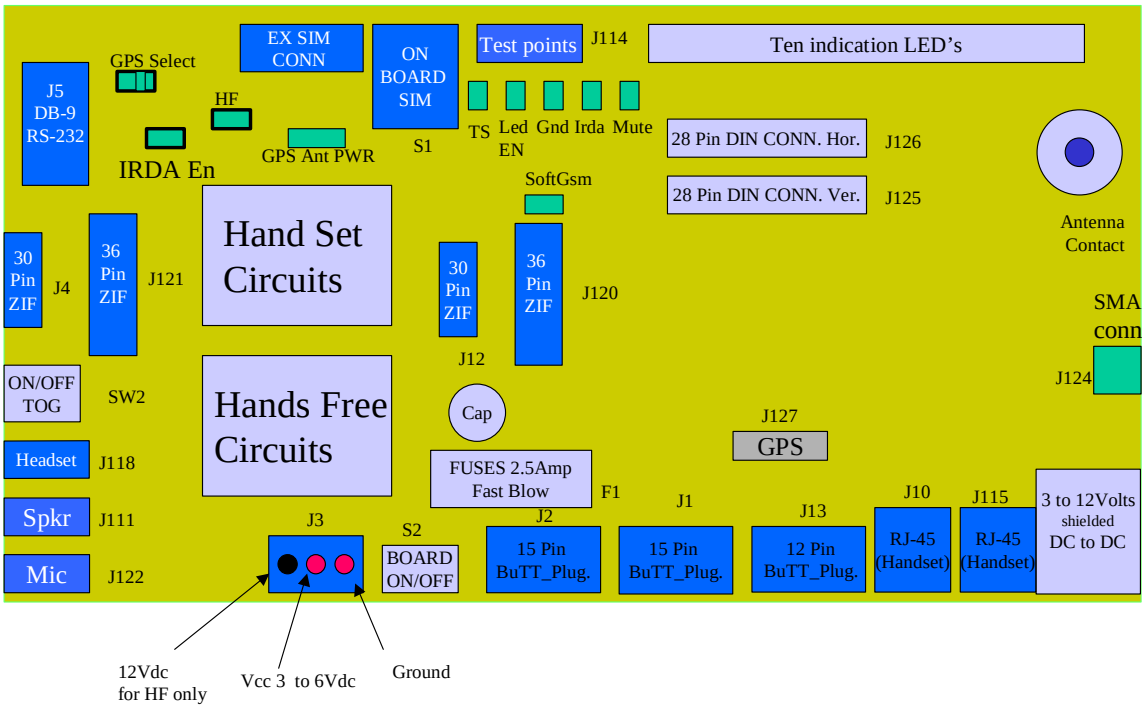


Figure 54– EV board connectors P4

Connector Description:

J5 - RS232 connector.

- This connector has the 8 RS232 lines (DTR,DSR,RTS,CTS,TXD,RXD,DCD,RI).
- These lines are the RS232 lines from the g18 output converted to RS232 levels.
- The D-type connector can be use to drive the GPS TXD,RXD lines.
- When the GPS_Select Jumper is inserted the TXD/RXD lines from the GPS connector are driven to the RS232 connector instead of the D15 signals.

J4 - D10 output. Flex Connection to the host device.

J121 - D15/G18 output. Flex Connection to the host device.

SW2 - On/Off Button.

- This push button switch is connected to the D15/D10 ON/Off line and use to turn On/Off the unit.

J118 - Headset connector.

J111. **Speaker connector** Used for Hands free applications.

J122 - MIC connector. Used for Hands free applications.

J3 - Power inputs.
- 3 to 6Vdc for the g18 and audio drivers in the EV board
- 12Vdc for the HandsFree drivers.

S2 - Power switch Turns on the 3-6V to the EV board.

J1, J2, J13 – Butt plugs connections. Used to connect standard accessories (EMMI, charger-for power input...)

J10, J115 - Handset connectors. Used to connect Handset and/or Remote SIM card reader.

J124 - Internal antenna connector.
This is an example how to design a tri-band internal antenna.

J120 - Connection to the D15/g18 under test - 36 pin.

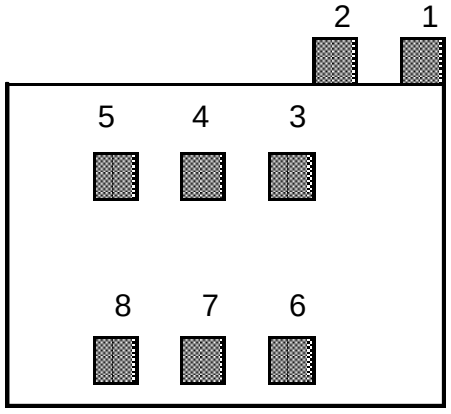
J12 - Connection to the D10 under test - 30 pin.

J125 - D15 DIN Vertical connector for unit under test - 28 pin.

Caution:
Any misalignment of 28 pin DIN connector when inserting into the EV board or host device may cause irreversible damage to the D15/g18.

J126 - D15/g18 DIN Horizontal connector for unit under test - 28 pin.

S1 - SIM connector.



Pin	Description
1	Gnd
2	SIM_PD
3	SIM_CLK
4	.*SIM_RST
5	VSIM1
6	SIM_I_O
7	SIM_-5V
8	Gnd

Figure 55– The SIM card interface

SIM - Additional SIM connectors. For extend SIM socket.

SIM Card Pin Function

Pin	Function
1	SIMPD
2	SIM_5V
3	*SIM_RST
4	DGND
5	N.C.
6	DGND
7	SIMCLK
8	DGND
9	N.C.
10	N.C.

J127 - GPS connector for Motorola M12 GPS module.

J114 - Test points of main functions from the D15 user connector.

J114 functions:

Pin	Function
1	CTS
2	TXD
3	DCD
4	DSR
5	RXD
6	RTS
7	SIM I_O
8	DTR
9	SIM_PD
10	SIM VCC
11	RI
12	SIM CLK
13	DCS_EN
14	DSC Downlink
15	DSC Uplink
16	2.7V for audio circuits

Jumper Description:

TS	- Use to turn on the unit any time that power is supplied.
Led EN	- Enable the LED operation.
GND	- Ground pins.
IrDA	- Future option. Not available at this time.
Mute	- This is a Test Point used for Hands Free operation, An input to mute the audio
SoftGsm	- When jumper connected the D15 will switch to SoftGsm mode. **In G18 this Jumper should be always open.**
GPS ant Pwr	- connect power to a GPS mounted in the EV board - Future option.
HF	- Jumper Not in Used. HF selection has done by SW.
GPS select	- Connect the GPS to the RS232 output - Future

Schematics Diagrams

Audio section for issue P4

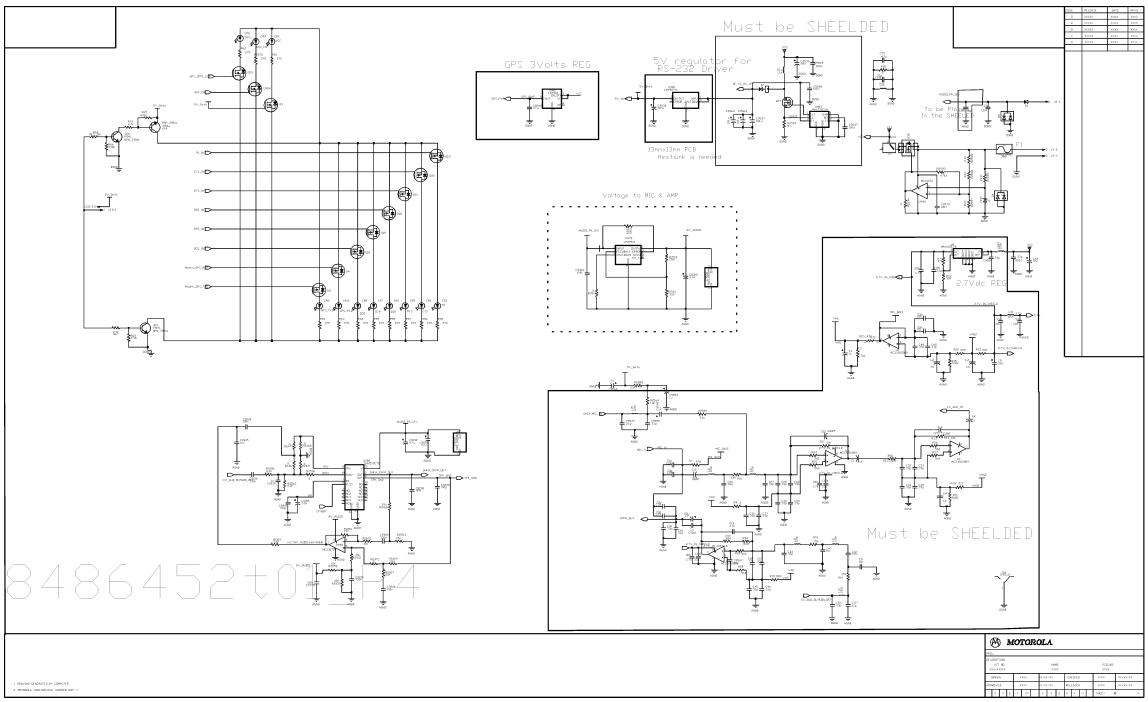


Figure 56–Audio Section for issue P4

Connectors section for issue P4

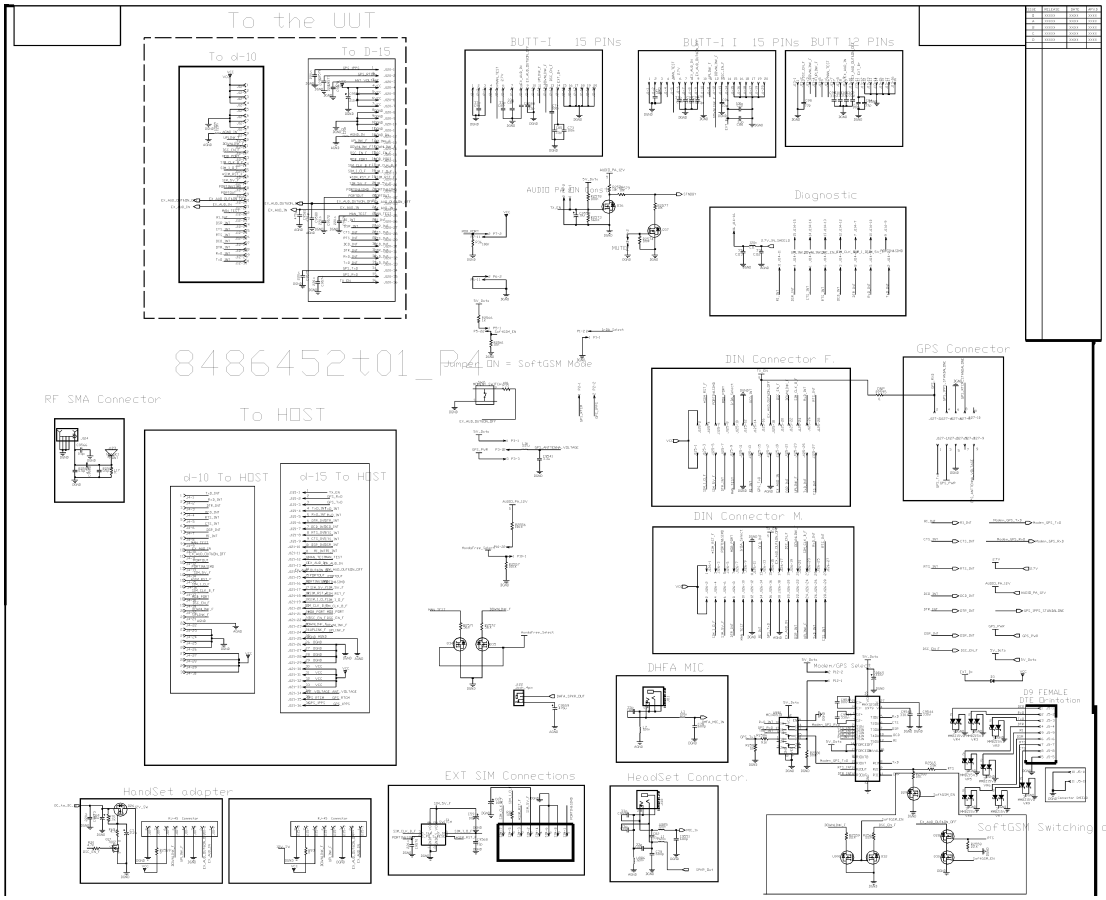


Figure 57Connectors section P4

Layouts

Top layer components only for issue P4

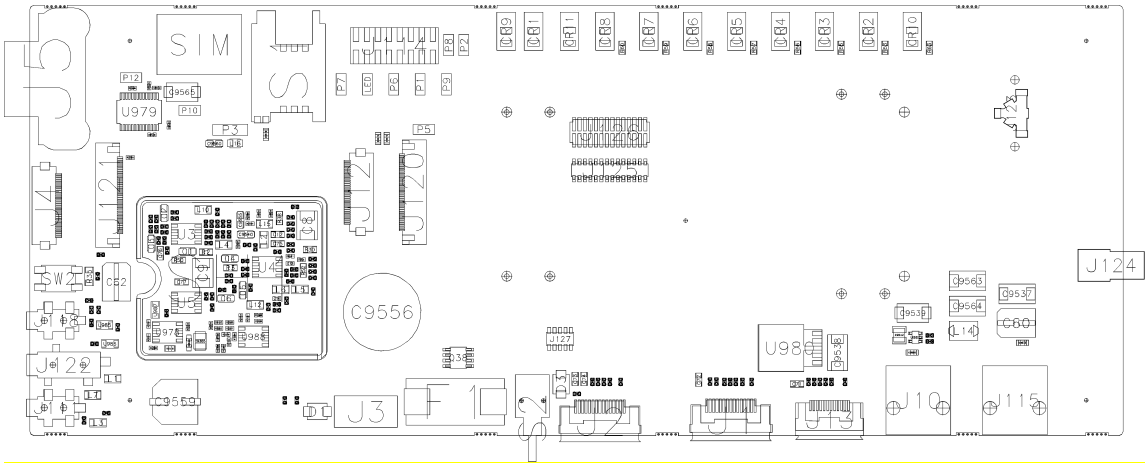


Figure 58 Top layer components only P4

Bottom layer components only for issue P4

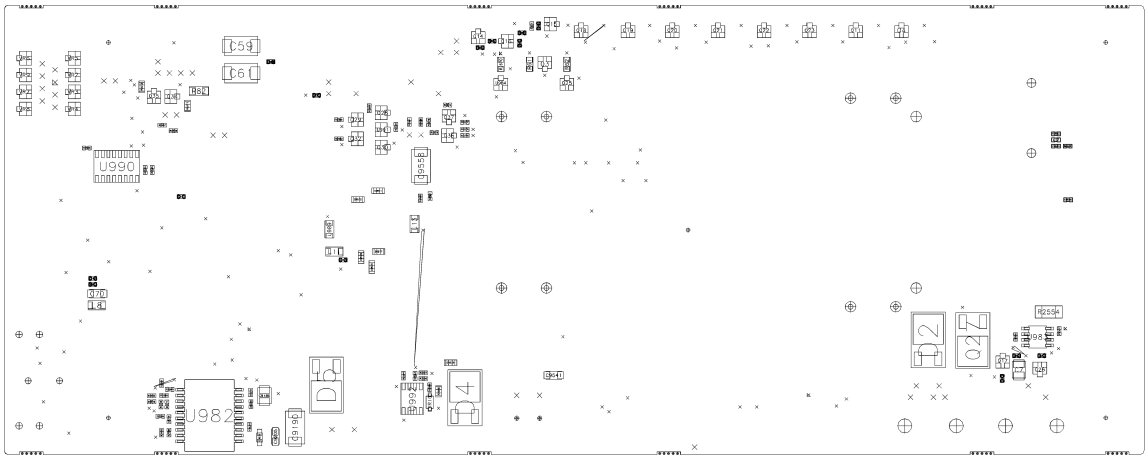


Figure 59– Bottom layer components only P4

EV Board Issue P5

To illustrate the connectivity option sees the follow figure:

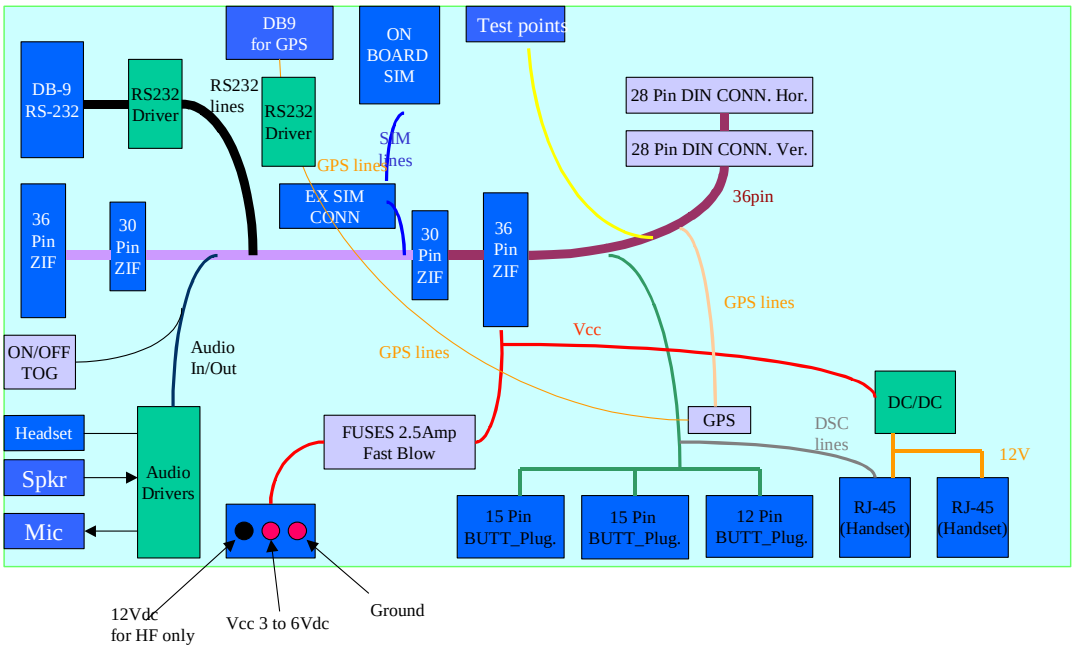


Figure 60 – EV board P5

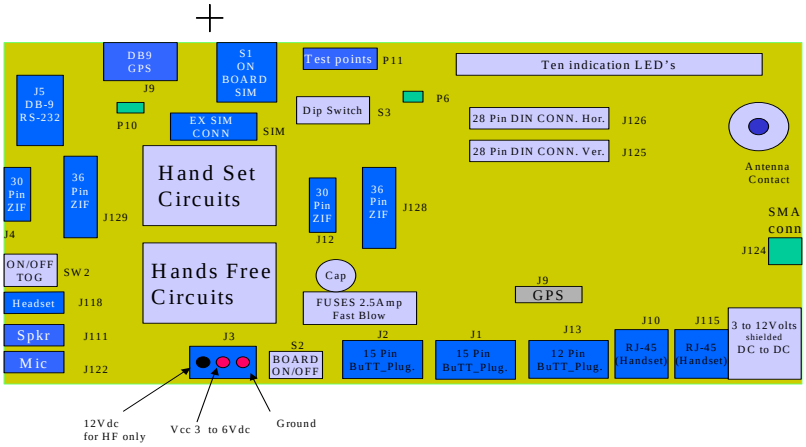


Figure 61– EV board connectors P5

Connector Description:

J5 - RS232 connector.
- This connector has the 8 RS232 lines (DTR,DSR,RTS,CTS,TXD,RXD,DCD,RI).
- These lines are the RS232 lines from the g18 output converted to RS232 levels.

J9 - GPS Connector for Debugging.
- This connector has the GPS TXD,RXD lines in RS232 levels.
- GPS 1pps and RTCM lines are routed directly to the g18 user connector.

J4 - D15/g18 output. Connection to the host device.

J129 - g18 output. Connection to the host device.

SW2 - On/Off Button.
This push button switch is connected to the g18/D15 ON/Off line and use to turn On/Off the unit.

J118 - Headset connector.

J111 Speaker connector. Used for Hands free applications.

J122 - MIC connector. Used for Hands free applications.

J3 - Power inputs.
- to 6Vdc for the g18 and audio drivers in the EV board
- 12Vdc for the HandsFree drivers.

S2 - Power switch to the board. Turns on the 3-6V to the EV board.

J1, J2, J13 – Butt plugs connections. Used to connect standard accessories (EMMI, charger-for power input...)

J10, J115 - Handset connectors. Used to connect Handset and/or Remote SIM card reader.

J124 - Internal antenna connector.
This is an example how to design a tri-band internal antenna.

J128 - Connection to the g18 under test - 36 pin.

J12 - Connection to the D15/g18 under test - 30 pin.

J125 - g18 DIN Vertical connector under test - 28 pin.

Caution:
Any misalignment of 28 pin DIN connector when inserting into the EV board or host device may cause irreversible damage to the g18.

J126 - g18 DIN Horizontal connector under test - 28 pin.

S1 - SIM connector.

See Figure 15 for connector details.

SIM - Additional SIM connectors. For extend SIM socket.

SIM Card Pin Function

Pin	Function
1	SIMPD
2	SIM_5V
3	*SIM_RST
4	DGND
5	N.C.
6	DGND
7	SIMCLK
8	DGND
9	N.C.
10	N.C.

J127 - GPS connector for Motorola M12 GPS module.

P6 GND - Ground pins.

P10 GPS ant Pwr - connect power to a GPS mounted in the EV board - Future option.

P11 - Test points of main functions from the g18 user connector.

P11 functions:

Pin	Function
1	CTS
2	TXD (input to g18)
3	DCD
4	DSR
5	RXD (Output from g18)
6	RTS
7	SIM I_O
8	DTR
9	SIM_PD
10	SIM VCC
11	RI
12	SIM CLK
13	DCS_EN
14	DSC Downlink
15	DSC Uplink
16	2.7V for audio circuits
17	GPS - RTCM
18	GPS 1PPS
19	TX_EN
20	HF Mute input (for customer application)
21	GPS TXD (output from g18)
22	GPS RXD (Input to g18)

S3 Dip Switch Description:

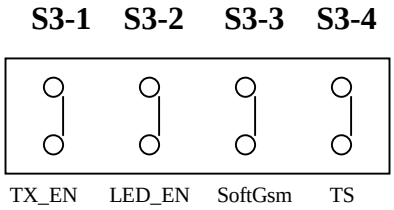


Figure 60 – Dip switch description

S3-1 TX_EN - Used to open the audio channel for the HF when a call is active and mute it when no call is activated when S3-1 is open than HF audio channel is active always.

S3-2 Led EN - Enable the LED operation.

S3-3 SoftGsm - When it Closed the D15 will switch to SoftGsm mode. **In G18 it should be always Open.**

S3-4 TS - Use to turn on the unit any time that power is supplied.

Schematics Diagrams

Audio section for issue P5

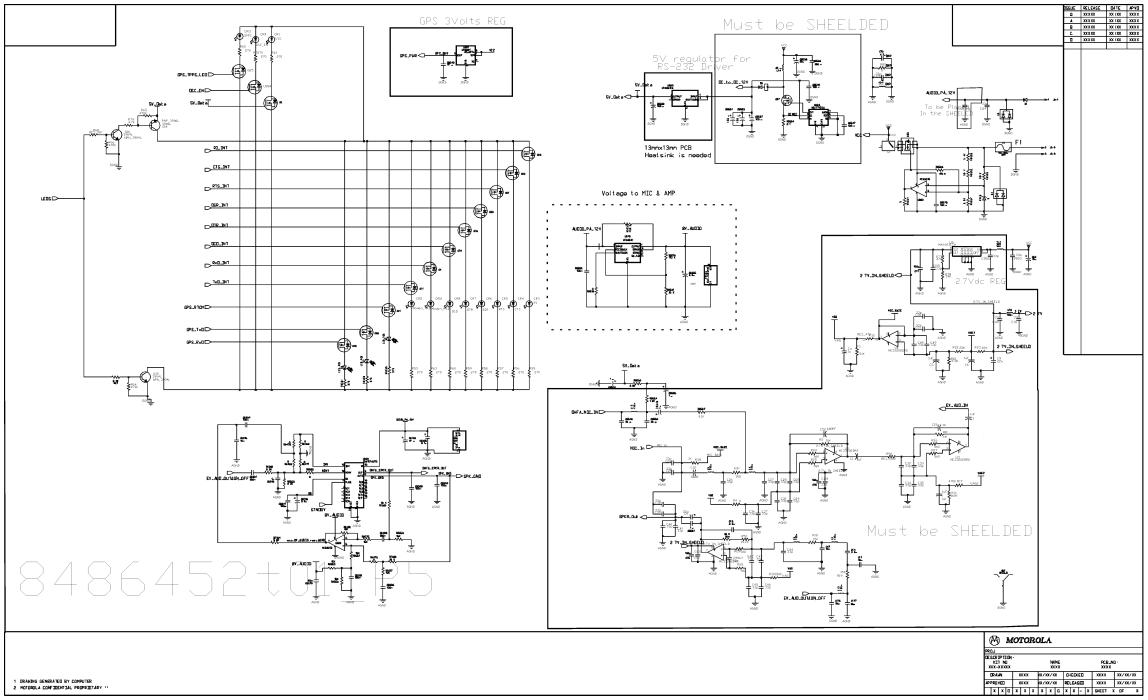


Figure 63– Audio section for issue P5

Connectors section for issue P5

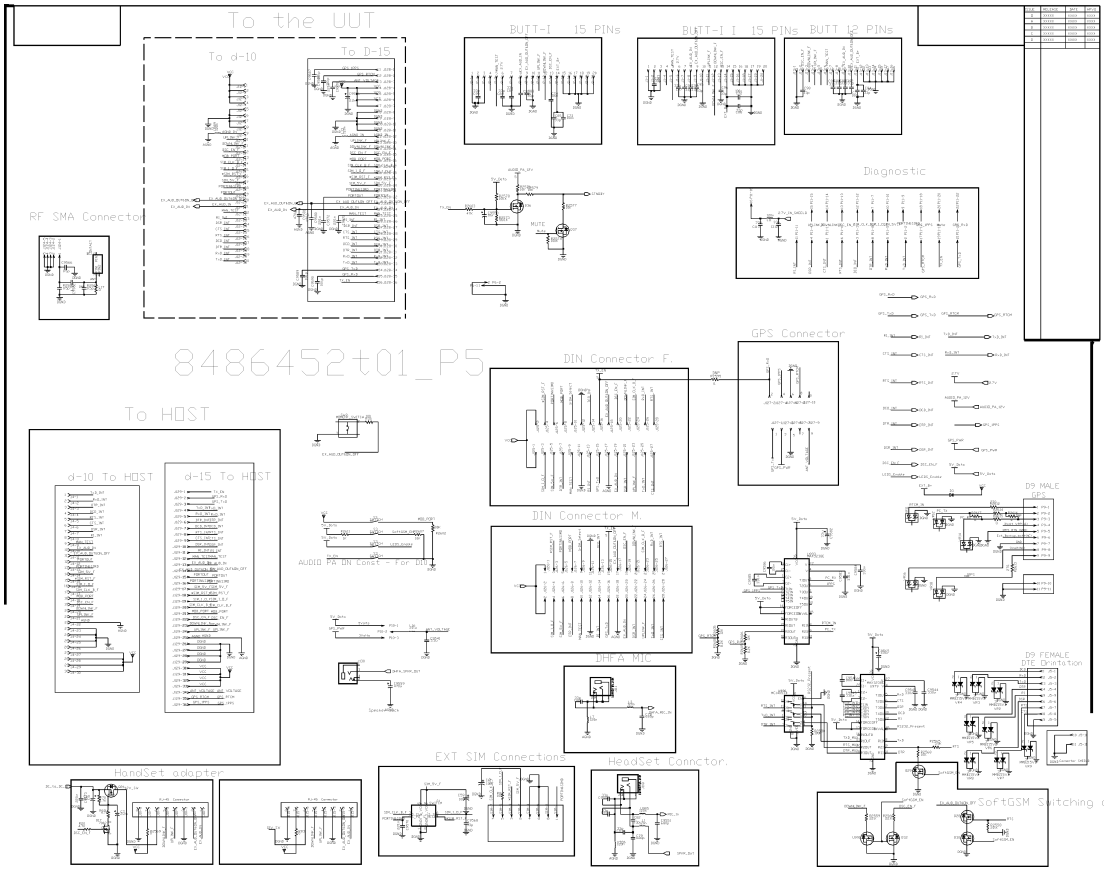


Figure 64– Connectors section for issue P5

Layouts

Top layer components only for issue P5

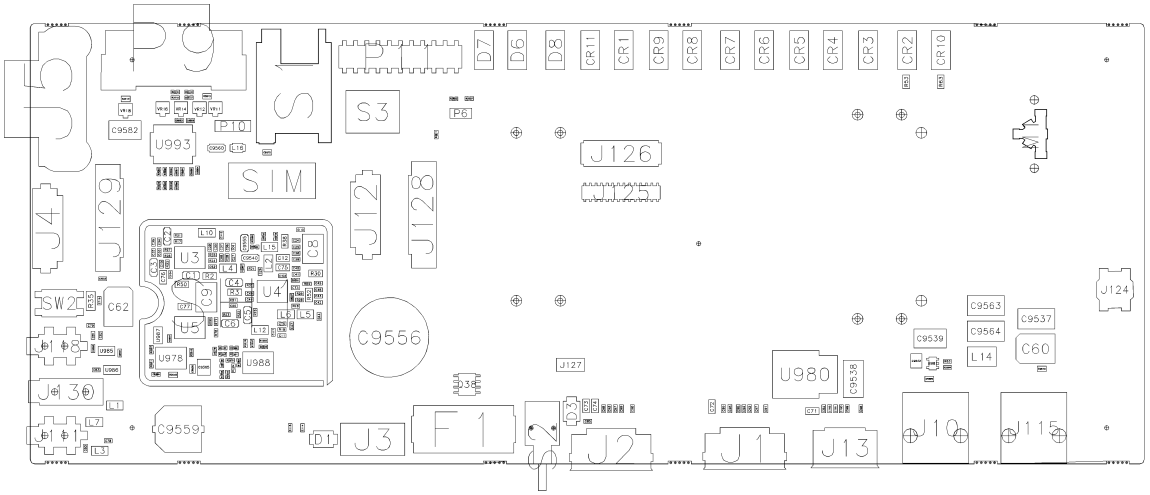


Figure 65 – Top layer components only P5

Bottom layer components only for Issue P5

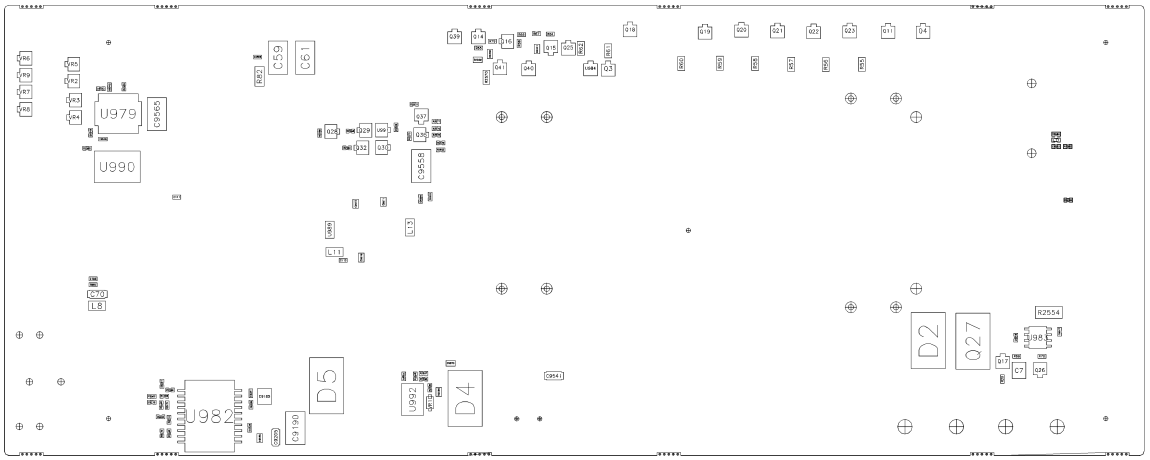


Figure 66 - Bottom layer components only P5

Annex E QUICK START

1. Power connection

The basic operation needs a single power supply 3 to 6 V connected to the EV board J3.
When external Speaker and microphone are used (HF operation) than an additional 12V power supply is needed.
Use switch S2 to power the EV board.

2. g18 connection.

For all models that have a 36 pins ZIF socket, connect the g18 via a 36 pin FC to J120.
For g18 in DIN Horizontal connect the g18 to the EV board in J126 or by using a flex cable between 36 pin ZIF socket and J120.
For g18 in DIN Horizontal connect the g18 to the EV board in J125.

3. Customer connections

For PC evaluations connect to a 9 pin D-sub connector J5.
For customer application, connected to host device with flex cable to J121.

4. Audio connection

Headset - Connected to J118 - marked HEAD SET.

For hands-free:
Microphone - Connected to J122 -Marked MIC
Speaker phone - connected to J111 - Marked SPKR
Handset connects to J10 or J115 - Both in parallel.

5. SIM connections

The SIM can be connected in 4 ways:

1. Internally in the g18.
2. In the SIM socket at the EV board S1.
3. Externally via connector marked SIM.
4. Remote SIM via the DSC bus (in the handset).

6. Band Selection

The default setting of the g18 is for 900/1800MHz band (GSM/DCS).
For PCS operation you need to change band using one of the following option.

1. Using Handset -Go to Menu/Network/Change Band and select 1900 Band.
2. Using AT commands - Send AT+CBAND=3 (for GSM/DCS=4).

Note: g18 needs power cycle to apply the band change

7. RS232 Connection

The g18 is a DCE device. Connect the RS232 lines according to the host device type (DCE or DTE) See details in paragraph 3.3 .

8. Antenna Connection

When long 90 degree MMCX connector need to be used, you can find it in Conectec.

9. Default Dip switch/Jumper setting

In EV_P4

TS	Open
Led EN	Closed
GND	Open (Test point)
IrDA	Open (Not Used)
Mute	Open
SoftGsm	Open
GPS ant Pwr	3V
HF	Open
GPS select	Open

In EV_P5

S3-1	Open
S3-2	Closed
S3-3	Open
S3-4	Open

Note:
The SoftGsm function must be disable in order to be able to communicate in RS232 (In EV_P4 SoftGsm jumper is open and in EV_P5 Dip switch S3-3 is open)

Annex F Desense

When you integrate wireless data radio technology into computing and telemetry devices, you must consider hardware issues related to RF emissions. For example, you must address the technical aspects of enabling a wireless RF device as an integrated peripheral in a host device, such as RF performance and inter-operability with the host.
Specifically, this chapter describes the following:

The term desense
- Preferred test procedures
- Acceptable levels of electromagnetic interference (EMI)
- Approaches to solving desense problems
- Pertinent radio and antenna issues

If desense was detected than a few actions can be done:

1. **Connect the antenna cable shield to the main ground (PS ground).**
2. **Shield the logic section in the user application. (most of the radiation can come from clocks and data lines around the logic section due to the high rise/fall time of the pulses).**
3. **A Ferrite can be wrapped around the antenna cable.**
   Recommended ferrite: Fair Rate # 2643023002 or # 0431173951.

NOTE: This chapter considers but does not attempt to resolve these technical issues for a particular platform. That is beyond the scope of this guide.

1. Desense Defined

Receiver desensitisation occurs when an unwanted signal is present at the radio receive frequency. The signal is usually the result of harmonic energy emanating from a high frequency, non-sinusoidal source. This noise desensitizes or lowers the sensitivity threshold of the receiver.
The radio cannot differentiate between wanted and unwanted signals. In frequency modulated systems, the radio receiver can capture the strongest signal present. If wanted and unwanted signals are present and there is not a significant difference in level, the unwanted signal can overtake the receiver, effectively blocking the wanted signal (see Figure27).
Consistent and reliable reception occurs when a safety margin dictated by co-channel rejection is maintained. For example, if the co-channel rejection is 10 dB, all unwanted signals must be 10 dB below the receiver's sensitivity level. Some modems and networks have different rejection levels. Use the rejection level appropriate for your modem. This means an interference signal that is more than 10 dB below the wanted signal has little impact on the data receiver's data recovery. Any interfering source above this level creates desense, reducing the radio's sensitivity for data reception. For every one dB above the threshold level, one dB of desense is created.

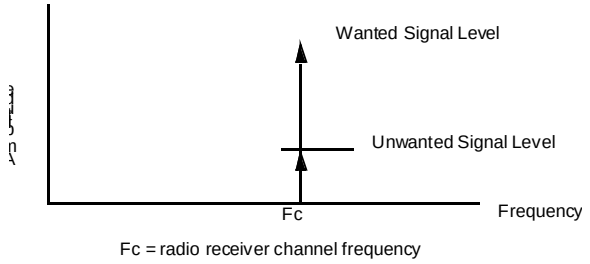


Figure 67- wanted and unwanted signal levels

2. Noise Sources

CPU clocks, address and data buses, LCD refresh, switching power supplies, and peripheral drivers are the primary contributors of EMI (Figure 28). The frequency of these emissions is often unstable. One reason for this instability is that high stability clock sources are not a requirement in host computer designs.
The frequency of sources drift as a function of temperature, time, and aging. Other sources by nature move within the frequency spectrum as a function of time. The edges of clock signals create detectable harmonics well into the 1 GHz band. This presents a challenge in measuring the effects of the emission, as one must first determine where the emission exists in the frequency spectrum.
Noise from the host can conduct through the electrical/mechanical interface or radiate electromagnetic fields that are received by the modem antenna and impact the modem. Motorola modems are specifically designed to minimize conducted noise.
Radiated electromagnetic fields emanating from the internal circuitry are incident on the modem antenna. These fields then are converted to noise power by the antenna and are incident on the receiver. The physical interface signaling connection has less impact on the receiver performance and can be electrically decoupled using passive components.

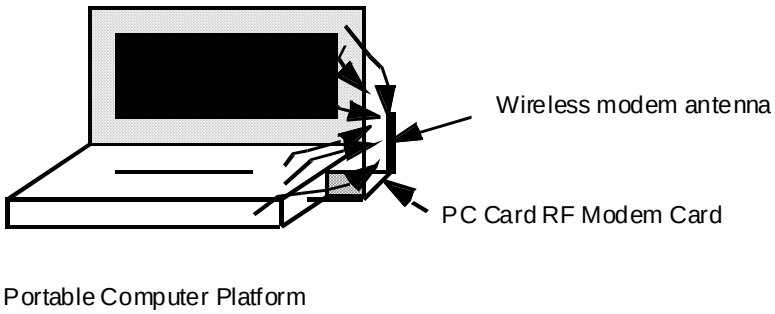


Figure 68 - EMI in a portable computer platform

3. Receiver Susceptibilities

The Receiver is susceptible to being desensed within the channel bandwidth and at intermediate frequencies used for down conversion. Consult the particular receiver specifications for IF frequencies. Excessive noise on power supply pins can also create sensitivity problems.

4. Measurement Techniques

Desense can be measured in one of the following ways:

- Indirectly by recording the emission level from the host and then calculating the effect on the modem.
- Directly by using packet error rate testing off air.

Testing directly is preferred method because it is more of a system test.
The test must be non-intrusive. Peripheral test cables or apparatus must not be connected to the unit under test, as they can have a significant effect on the receiver sensitivity results.
Indirect testing is essentially FCC Part 15 EMI testing that occurs today. Bear in mind that some assumptions have to be made to extrapolate the results and convert them to desense figures. Of course, these assumptions can create some error in the prediction.

5. Packet Modem Integration Tester (PMIT)

PMIT for the g18 module is to be developed. The following provides an overview only. To enable non-intrusive, labor-saving testing of desense. A PMIT session measures and records the sensitivity of every channel in the receive band. PMIT produces a RF level versus channel frequency data set to help determine system coverage. Figure29 illustrates the PMIT hardware facility to obtain testing using PMIT, consult your Motorola OEM support group for details. Special conditions apply to receipt and usage of the utility.

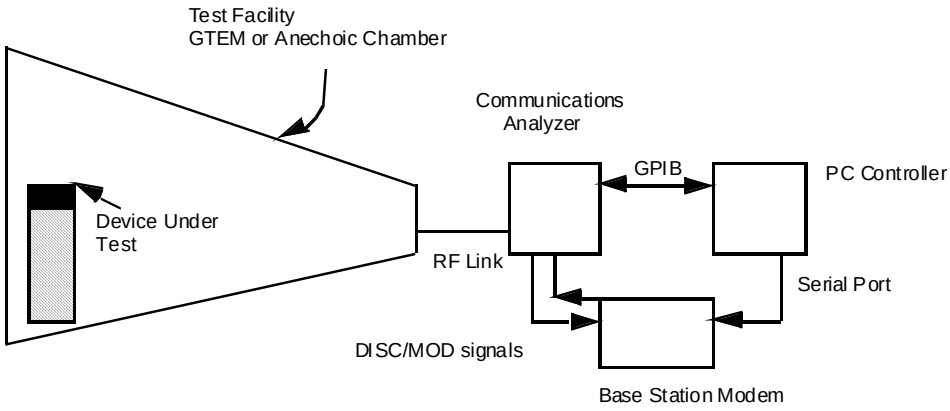


Figure 69 - PMIT hardware facility

6. PMIT Data Presentation

PMIT produces two columns of data that can be ported to any two-axis linear plotting program. A typical PMIT plot is shown in Figure 30. The plot provides the RF level required to produce 1% BER at any channel within the test range.

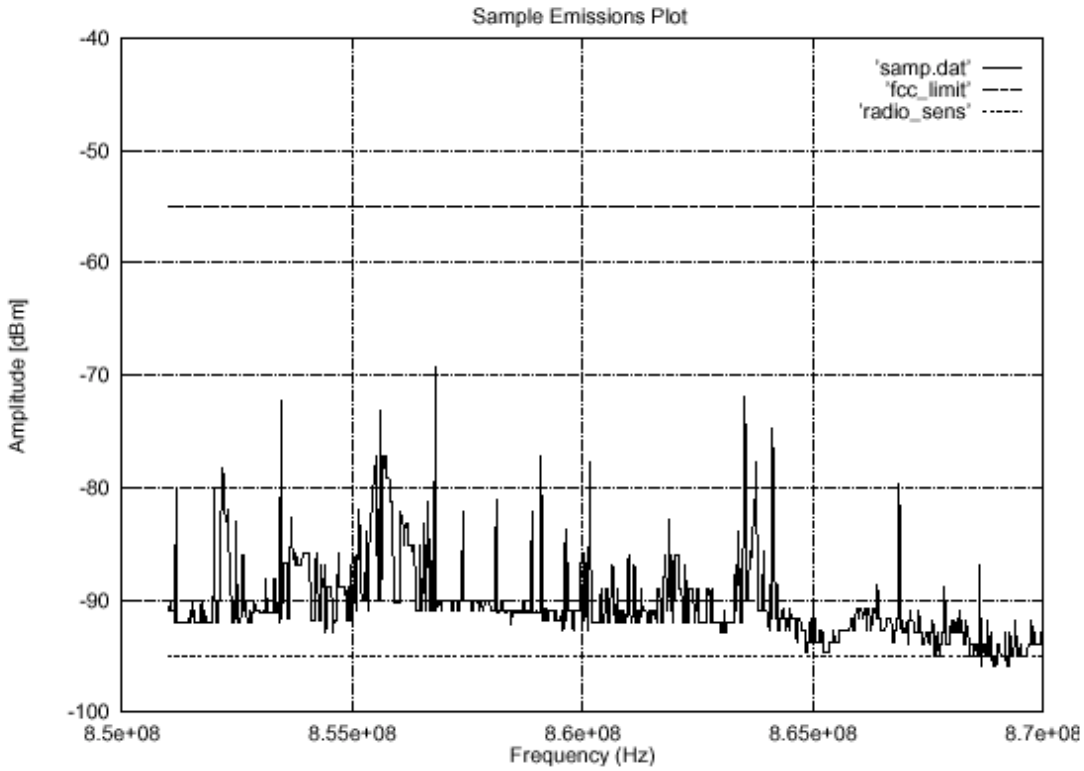


Figure 70- A Typical PMIT Plot

7. Alternate Measurement Method

Using a spectrum analyzer with input impedance of 50 W, connect the antenna of the product under test to the analyzer as shown in Figure31. If an antenna is currently not developed, use a portable dipole antenna as a measurement antenna.

The measurement apparatus is capable of measuring signals as low as –120 dBm. A preamplifier is required to allow the spectrum analyzer to achieve these levels. Use the analyzer's smallest possible resolution bandwidth, typically 1 kHz, to improve the dynamic range of the measurement.

If the input impedance of the analyzer is the same as that of the radio receiver and the antenna, you can measure the noise to which the receiver will be subjected. The gain on the low noise amplifier (LNA) will make low level noise more visible. Ensure that the spectrum analyzer's input is not over driven by other RF signals, such as FM radio stations. Any spikes that appear might cause desense problems.

The indirect method cannot account for characteristics of the data protocol and is less effective. Also, the bandwidth of the noise source is important. If the source is narrowband, it has less effect than one occupying

the entire channel bandwidth. The method is not effective in determining desensitization at IF frequencies or from less obvious sources such as mixed products. The method provides information on how much effort, if any, needs to occur to resolve desense problems.

This method is useful when connection of the wireless card is not yet facilitated by the platform. This measurement could be performed without the wireless card present. This method determines the magnitude of the emissions without extensive test facility requirements.

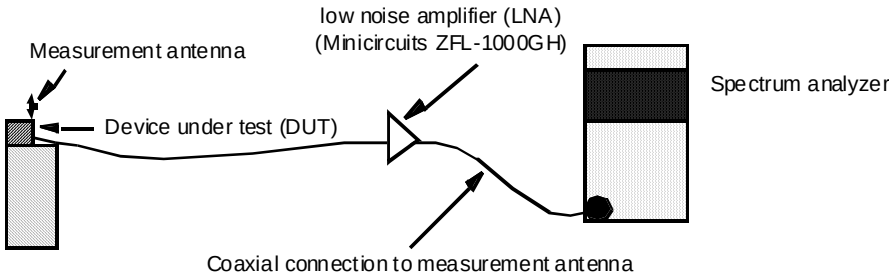


Figure 71 - Spectrum Analyzer setup

8. Preparing the Device Under Test

All battery-operated portable devices implement power management. This means devices are shut down in stages as time elapses. To provide an effective test condition, each product should include a test mode in software that powers up all non-passive circuitry. In addition, you are advised to deploy a pseudo-random-based routine that exercises all circuit blocks and peripherals. This ensures that desense testing considers the worst-case scenario.
PMIT testing can take up to three hours to complete. The device under test (DUT) must remain powered during the entire test cycle. For this reason, use external power sources to maintain operation during testing when possible. Typical circuit blocks to power on and exercise include:

- Display characters and backlighting
- Interface drivers and power supplies
- Keyboard scanning
- Peripheral silicon
- Mass storage devices and controllers

You can also emulate keyboard or tablet activity. Some devices generate the bulk of their emissions during user interaction.

9. Performance Goals

Network coverage is the ultimate goal of emissions control. The allowable emissions levels are a function of the radio sensitivity and the required network coverage.

10. Radio Performance Capabilities

Each radio technology demands certain sensitivity requirements. Wide area networks require the subscriber device to be very sensitive, while local area networks operate with higher receiver-signal levels.

Highly sensitive radios are more susceptible to noise from the host platform. For example, assuming a 10 dB co-channel rejection, a less sensitive receiver tolerates a higher level of noise.

FCC Part 15 Level Comparison

The FCC emissions limits for unintentional radiators are:

- 200 µV/M between 216 MHz and 960 MHz
- 500 µV/M above 960 MHz

These limits are for measurements conducted three meters away from the device.

As a reference, the theoretical noise level that the host device may emit without desensitizing the most sensitive receiver is ~ 40 dB below the FCC limits.

NOTE This calculation assumes the host device and the modem card antenna are isotropic sources.

11. Determine Emission Level Goals

To determine the allowable emissions levels from the host device, consider the following:

- The sensitivity of the wireless modem in use
- The targeted network coverage requirements

The expected proximity of the wireless device to the host platform

Achieving zero desense is not a realistic goal with a cost-sensitive commercial product. The following are one set of subjective levels based on industry experience:

- Channels desensitized by less than 9 dB are acceptable.
- Channels desensitized by more than 10 dB create a noticeable problem within the network.
- Channels desensitized by more than 20 dB are unacceptable.

Each case is different; each air protocol reacts in a unique way, and each network reforms differently under the same levels of unwanted ambient noise. Noise from the host above the desense threshold level does degrade the ultimate potential performance.

Narrowband interferers have a low probability of creating customer problems. Wideband sources have a higher probability of occurring at a channel frequency and thus have a greater potential for trouble. For this document, any emission that occupies less than 50 kHz of the frequency spectrum is considered narrowband.

12. Acceptance Analysis on a Sample Data Set

Consider the data set shown in Figure 32

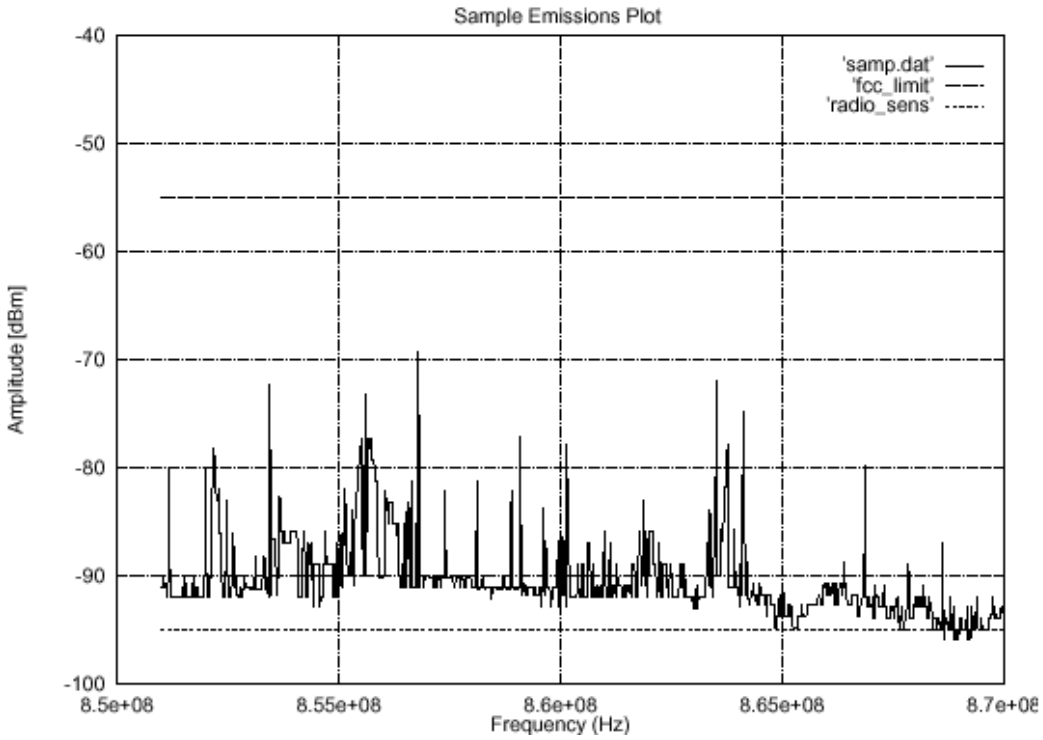


Figure 72: Sample data set

The measured sensitivity is a function of receiver performance, path loss in the test facility, and emissions, creating desense on certain channels.
The data set in Figure 32 is typical of a host system. The upper dashed line represents the equivalent FCC Part 15 Class B emission level. The lower dashed line is the maximum sensitivity capability of the radio receiver. The data set plot (solid line) is the actual performance of the radio receiver as used with the host platform.
If the host unit met FCC limits from 851 to 870 MHz, the effective sensitivity of the receiver would be reduced to -55 dBm in this test site. The capability of the receiver is -95 dBm, a 40 dB difference. The FCC limits are quite high in this frequency range. Most host devices are well below the limit at the majority of frequencies.

The worst-case desense from this platform is ~25dB at a narrow spike near 856.5 MHz. The noise floor of the device is in the 3 dB range, which is good. There are a number of spikes that have a 10 dB impact on narrowband channels

The most notable emission response is at 855.5 MHz where a wideband emission is present. This response is a concern due to the number of channels it impacts and the probability of a user wanting to operate within that range. The level of desense is a considerable, 15dB.

13. Prediction of Sources

Determining the exact nature and source of each emission is beyond the scope of this guide, with the exception of some common scenarios. Common problems are evident in the sample data set. The large narrow band spikes are usually the result of harmonics from a clock source. You can determine which clock is creating the problem by checking whether the emission is a direct product of the clock frequency or a sub-harmonic of it.

For example, if your system runs a 16.8 MHz clock, and a 1.23 MHz clock and a strong narrow band emission is found at 865.2000 MHz, it is reasonable to deduce that the emission is created by the 16.8 MHz clock as a product of:

865.2/16.8 = 51.5 The 51st harmonic plus a sub-harmonic of 8.4 MHz

The wide band emissions are normally a switching power supply. These emissions are created by the low frequency of the switcher modulating onto a higher harmonic of another source. Switching power supplies creates a lot of magnetic energy due to the need for inductive coils. In fact, any circuit using large inductors that are not toroidal is usually a source of noise.

Some emissions are tricky to pin down. They may result from multiple order mixing of any number of sources. The best way to discover these is to shut down sources one by one and see if the emission disappears. Near field probing allows a geographical fix on the emission once the source circuitry is identified.

Noise floor problems, where the entire receives band is desensed, preclude all methods of tracking down individual sources.

A loop probe is a useful measurement tool for confirming emissions sources. This probe must be small enough to pinpoint an area from which the emission is radiating but large enough to provide adequate sensitivity.

14. Probability of Channel Interference

The probability of a strong interference source landing on a channel of interest is actually quite low. The possibility does exist, especially in single-channel systems, rather than multi-channel systems. A multi-channel system provides a number of frequencies at which to operate.

Using probability to desense a channel only works with narrow band sources. A wide band emission increases the probability of desensing a channel proportional to the bandwidth it occupies.

You can calculate the probability of an interference source coinciding with a channel frequency. To do this, consider that the source usually drifts over a range of frequencies, increasing the possibility that the two will coincide. Provide stable clock sources within the host to allow for better prediction and control of which channels will be affected by the noise.

15. Desense Scenarios

The target of 40 dB below FCC Class B guarantees no desensitization. The typical scenarios that work in favor of the system are as follows:

- The host unit is usually in a power management state, either completely asleep or in a reduced functional state. This reduces the EMI and allows for improved wireless communications.
- In most systems, multiple channels are usually available for operation. If one is desensitized, the radio can choose to operate on another. This greatly reduces the potential coverage problems, and channel switching is transparent to the user.
- The system continues to function even after being interfered with. Coverage range is reduced. In some applications, this is not a problem. This could be true for users who do not stray into network fringe coverage areas.
- Two-way protocols can retry unsent messages.

Each platform, network operating model, and user profile is different. As such, each application requires a unique level of EMI reduction effort.

16. Methods of Controlling Emissions

Preferred methods of controlling emissions observe that the emissions must be contained to a level 40 dB less than the FCC Part 15 requirements. For WAN products, the accepted method of achieving this is to shield.

Through past experience, it has become evident that standard techniques used to achieve FCC certification are not enough to satisfy wireless communications. Engineering teams logically attempt an array of decoupling, partial shielding, and PCB layout methods, which produce incremental improvements, but do not achieve the emission control requirements. Hybrid methods of shielding and source reduction are often a good approach.

IMPORTANT: Unless the host platform is already close to the goals set out in this document, source reduction efforts may only drive up the direct materials cost of the product and not increase return on that investment.

If a compromise is chosen where the target levels are not the goal, standard EMI techniques can be of value. For narrow band emissions, some form of clock frequency "pulling" or control can be implemented.

16.1 Shielding Approach

The mechanical design of the host product must allow the EMC engineers to create a Faraday Box shield design. This is an electrically continuous shielded enclosure. If designed properly, such an enclosure easily attenuates radiated signals from the host device.

The shield approach appears to be a big step at first. The advantage is that the shield will minimize the possible redesign required of the host PCB platform and circuitry.

For a thorough discussion of shielded enclosure design, an excellent reference is *Electromagnetic Compatibility: Principles and Applications* by David A Weston. The publisher is Marcel Dekker, Inc. 270 Madison Avenue, New York, NY 10016. Any well-written text on EMI control probably covers the design of shielded enclosures.

16.2 Components of the Shield Design

To be effective, the shield design must incorporate:

- A highly conductive shielded enclosure that encapsulates all of the active circuitry. This can be constructed of sheet metal or plated/sprayed plastic.
- Decoupling on all signals exiting the enclosure
- Control of aperture sizes in the shield to less than l/10 of the frequency of interest. This would apply to keyboard and display apertures in the enclosure. Testing of aperture radiation at the frequencies of interest may prove larger apertures are acceptable to the particular scenario.

17. Benefits of the Shielding Approach

Emissions reduction can be achieved using shielding source reduction techniques, such as decoupling, or PCB layout and grounding, or a combination of the two. Once a shield is in place, any revisions to product circuitry have no effect on emissions levels. If a circuit level approach is used to control the emissions, a change in circuitry can bring a new unknown to the emissions performance.
In addition, perfecting shielding designs now will provide a jump on future requirements for emissions reduction. With the proliferation of wireless communications, the emissions levels will need to be reduced. We feel it is inevitable that the FCC will tighten up the Part 15 regulations.

18. Alternate EMI Reduction Methods

Although shielding is the brute-force method of reducing emission levels, other methods are available, such as:

- PCB layout modification using ground layers adjacent to high speed layers
- Capacitive or filter decoupling
- Redistribution of module interconnects
- Clock pulling

18.1 Clock Pulling

Clock pulling is effective when the emission sources are narrowband (Figure33). To implement clock pulling, a method must be devised for the modem to tell the host it is having difficulty receiving. Devising such a method is admittedly very difficult. The host provides pulling of its internal emission source, which is identified as a potential problem.
If this source is the cause of the interference, the pulling or slight shift of the source frequency moves the harmonic energy out of the receive channel. This is an inexpensive way of solving the problem, as no special shielding or decoupling is required.

The limitations of the clock pulling method are:

- Computing devices have many more than one source
- Each source must be identified and controlled. This identification is at times difficult.
- The host and modem must communicate the problem at hand to attempt to correct it.

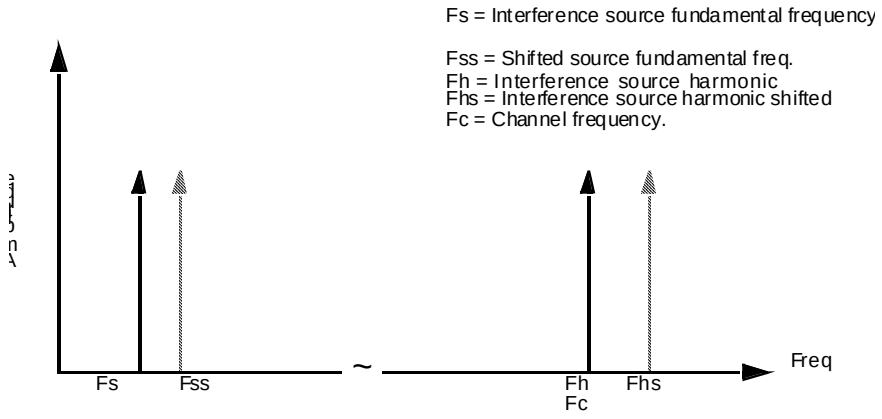


Figure 73 – Clock pulling

19. RF Network Issues

Each RF network has its own requirements for the subscriber device. Most networks implement a coverage equalization scheme. This consists of configuring the infrastructure sites such that their RF power output is equal to that of the subscriber device.

Since most portable devices are battery operated, the transmitter power of the portable units is relatively low. To compensate for this, the base site transmitter power is decreased to a level equal to that of the portable. The base site has a much larger and

Reliable power source, and is capable of putting out more power. This helps overcome desense problems that the portable unit incurs. Most network managers prefer not to increase their site power because of ERP licence limitations and cell overlap issues.
Network operators must consider ambient noise levels when designing their coverage plans. Once the wireless modem and host unit are engineered not to self-desense, a host of other machines in the user's environment can still impact radio performance. These machines are not usually within close proximity of the wireless modem antenna and have less effect. An FCC Class B radiator can impact the wireless device if it is within 30 meters of the device, assuming that an emission exists at the channel frequency of the radio.

Networks can assist in the desense problem by offering more than one channel frequency at which to operate. If the radio encounters interference on a channel, it can then roam to another.

WAN protocols include retry mechanisms that resend messages not acknowledged from the subscriber device. These protocols can correct problems from intermittent noise sources by retrying during a time slot that does not coincide with noise source interference.

At a certain point, desensitising a wireless modem receiver creates unacceptable coverage in the network. This usually is in the 10 dB range, though it can vary with networks.

20. Antenna

The Motorola g18 wireless modem is not equipped with an on-board antenna. You must provide one within the host device.

20.1 Field Strengths from the Antenna

Field strengths from the wireless modem transmitter can reach as high as 100 V/M for WAN products. Harden the host device to withstand these levels. LCD displays and switching power supplies are particularly susceptible to RF. Capacitive decoupling of sensitive areas is required. Decouple the reference voltage points on power supplies, reset lines on processors, and keyboard scanning circuitry.

20.2 Antenna Interactions

There are two interactions that can impact the performance of the antenna.
By placing a hand near the antenna, the user can detune the antenna and absorb energy. Accordingly, the antenna must be positioned such that interaction between the user and the card is minimized.
The host device might also interact with the antenna. This is particularly true for WAN modems, which have higher output power. An imaginary sphere of real estate should be provided for the antenna to function. Cabling for other peripherals must not interfere with this region.

20.3 Antenna Cable Routing

The coaxial cable used to connect the modem to the antenna must be routed away from noise sources such as oscillators, bus lines, or noisy CPUs. These noise sources generate broadband noise that will radiate and be picked up by the antenna cable. In addition, this cable should be kept as short as possible. Avoiding noise sources is the primary goal, so within reasonable limits, length can be added to allow routing away from noise sources.
When long 90 degree MMCX connector needs to be used, you can find it in Conectec.

21. Desense Summary

Desense considerations fall into two categories when using a wireless device and computer as a system:

- The impact of the computer's EMI on system performance
- The impact of the RF fields from the wireless device transmitter on computer operation

The latter consideration is not a significant problem. If RFI is assessed properly, it is usually corrected with little effort and cost.
Because of the need for system coverage, the host EMI interaction with the radio receiver can be a significant and often elusive problem to characterize and correct. Most computers are very fast and include numerous high frequency radiators. These can interfere with the radio reception of the wireless modem.
The theoretical levels at which the receiver might be impacted are derived from system coverage requirements and the sensitivity of the radio. These goals are not set arbitrarily to improve product performance but to maintain the RF performance the networks demand and the radios are designed to deliver.
Since each product is unique. The level of noise is very difficult to predict, as is the amount of effort needed to control it. Measuring the product in an early engineering phase is key to managing the situation.

Annex G IPs over AT commands list

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The commands described are the AT commands set and the new IP over AT service.

1. General

The old DSC bus IP primitives set is giving complementary radio internal information via commands per request as well as unsolicited indications.
Since the AT commands set is not giving a complete radio internal indications, a new AT interface is introduced in order to provide these complimentary IP primitives via RS232 serial port in a standard interface (AT).

This service is called CIP.

The AT commands are generally an atomic operation where only one command is execute at once.
The user may enable or disable some unsolicited AT indications, on a command base.

The CIP service can be enabled or disabled by the user, but once the user enable the CIP service, he will get an unsolicited IP primitives based on the internal radio events. The CIP enable will allow the user to send the IP primitive requests and to get its confirms.

2. Enable IP over AT services +CIPE

+CIPE Parameters command syntax

Command	Possible response(s)
+CIPE=<cipen>	
+CIPE?	+CIPE: <cipen>
+CIPE=?	+CIPE: {list of supported <cipen>s}

Description

Defined values
<cipen> `
0 IP over AT services (+CIP) is disabled
1 IP over AT services (+CIP) is enabled

Example

at+cipe?
+CIPE: 1

OK
at+cipe=?
+CIPE:(0-1)

OK
at+cipe=1
OK

3. DSC bus IP Primitive over AT services +CIP

+CIP Parameters command syntax

Command	Possible response(s)
+CIP=<len>,<primid>,<subadd>[,<primdata>]	+CIP:<len>,<primid>[,<primdata>] +CME ERROR: <err>
+CIP?	+CME ERROR: <err>
+CIP=?	+CME ERROR: <err>

Description

Defined values

<len> The length (number of characters) of the field: <primdata>.
The value of the length is in decimal.
If the field <primdata> is not exist, then <len> is: 00 .

<primid> The IP primitive ID (please refer to paragraph 5.4 for the list of the supported IP's).
The value is two hexadecimal bytes, represented in 4 (ASCII) characters.

<subadd> The sub address within the XCVR, for routing this IP primitive (please refer to paragraph 5.4 for the list of the IP's subaddresses).

<primdata> The data of the specific IP primitive (please refer to paragraph 5.4 for the list of the supported IP's). This data will have padding bytes at the end of the primitive structure due to ARM 32bit alignment.
The number of padding bytes is defer from 0 to 3*N (N > = 0).
The padding bytes should be count in the <len> field.
The terminal / TCU should ignore these bytes.

Example

1. CIP Request (IP_ERROR)

AT+CIP=10,A87E,0020,0003000000
+CIP: 24,a87f,0003FFFF434900000000FFFF

OK

The IP_ERROR_REQ primitive ID is: A87E (hex).
The sub address is 0020.
The data field is: 0003000000, it is 10 characters, which represent 5 Hex Decimal bytes:
0x00, 0x03, 0x00, 0x00, 0x00
The IP_ERROR_CNF primitive ID is: A87F (hex).
The data field is: 0003FFFF434900000000FFFF, it is 24 characters, which represent 12 Hex
Decimal bytes:
0x00, 0x03, 0xFF, 0xFF, 0x43, 0x49, 0x00, 0x00, 0x00, 0x00, 0xFF, 0xFF

2. CIP unsolicited indication

+CIP: 8,1406,00010004
+CIP: 16,a827,000000000000FFFF

AT+CIP=10,A87E,0020,0003000000
ERROR
at+cmee=2
OK
AT+CIP=10,A87E,0020,0003000000
+CME ERROR: "operation not allowed"

4. IP primitives supported by CIP

IP_CALL_DTMF_REQ	0xA835	0x0017
IP_CALL_STATUS_IND	0xA827	ind->IP
IP_CLASS_IND	0xA829	ind->IP
IP_HOOKSWITCH_IND	0xA809	ind->IP
IP_INDR_CTRL_STATE_IND	0xA825	ind->IP
IP_MUTE_REQ	0xA822	0x0017
IP_MUTE_IND	0xA808	ind->IP
IP_PD_USAGE_IND	0xA826	ind->IP
IP_STOP_REQ	0xA82F	req->IP
SEEM_ACTIVATE_CNF	0x1402	cnf->IP
SEEM_ACTIVATE_IND	0x1403	ind->IP
SEEM_CARD_STATUS_IND	0x142B	ind->IP
SEEM_DEACTIVATE_IND	0x1406	ind->IP
SEEM_PIN_CHANGE_CNF	0x1411	cnf->IP
SEEM_PIN_DISABLE_CNF	0x1413	cnf->IP
SEEM_PIN_ENABLE_CNF	0x1415	cnf->IP
SEEM_PIN_VERIFY_CNF	0x1417	cnf->IP
SEEM_STATUS_CNF	0x140f	cnf->IP
SEEM_UNBLOCKING_CNF	0x1419	Cnf->IP
IP_ERROR_REQ	0xA87E	0x0020
IP_ERROR_CNF	0xA87F	Cnf->IP
IP_LOW_VOLTAGE_IND[1]	0xA884	ind->IP
IP_NUM_OF_ATTACHED_PERIPHERALS_IND	0xA890	ind->IP
IP_ATTACHED_PERIPHERALS_INFO IND	0xA88F	ind->IP
IP_GET_HF_VOLUME_REQ	0xA886	0x0017
IP_GET_HF_VOLUME_CNF	0xA887	Cnf->IP
IP_HF_AUDIO_STATUS_IND	0xA888	ind->IP

[1] IP_LOW_VOLTAGE_IND – Not supported by g18.

IP_LTC_ERASED_IND	0xA88A	ind->IP
IP_SET_RING_LEVEL_REQ	0xA88B	0x0017
IP_SET_RING_LEVEL_CNF	0xA88C	Cnf->IP
IP_ABBR_DIAL_TBL_IND	0xA831	ind->IP

5. Request/Confirm primitives

REQ

IP_MUTE_REQ_ID (no_cnf)

IP_CALL_DTMF_REQ_ID (no_cnf)

IP_ERROR_REQ_ID
IP_GET_HF_VOLUME_REQ_ID
IP_SET_RING_LEVEL_REQ_ID

CNF

IP_ERROR_CNF_ID
IP_GET_HF_VOLUME_CNF_ID
IP_SET_RING_LEVEL_CNF_ID

sim card information

SEEM_ACTIVATE_CNF_ID:
SEEM_STATUS_CNF_ID:
SEEM_PIN_VERIFY_CNF_ID:
SEEM_PIN_CHANGE_CNF_ID:
SEEM_PIN_DISABLE_CNF_ID:
SEEM_PIN_ENABLE_CNF_ID:
SEEM_UNBLOCKING_CNF_ID:

6. Unsolicited primitives

IND

IP_ABBR_DIAL_TBL_IND_ID
IP_CALL_STATUS_IND_ID
IP_CLASS_IND_ID
IP_LOW_VOLTAGE_IND_ID
IP_MUTE_IND_ID
IP_PD_USAGE_IND_ID
IP_HOOKSWITCH_IND_ID[2]
IP_INDR_CTRL_STATE_IND_ID
IP_STOP_REQ_ID(txvr->periph)
IP_NUM_OF_ATTACHED_PERIPHERALS_IND
IP_ATTACHED_PERIPHERALS_INFO_IND
IP_HF_AUDIO_STATUS_IND
IP_LTC_ERASED_IND
SEEM_DEACTIVATE_IND_ID
SEEM_ACTIVATE_IND_ID

7. IP primitives CIP spec

7.1 Class Indicator

The transceiver sends an ip_class_ind primitive to indicate the current state of the phone. It is sent shortly after power up to all peripherals. It is also sent following a warm plug attach and whenever the current state of the phone changes.

This primitive contains several pieces of information very useful to peripherals at power up. This primitive is specifically designed to "get the ball rolling" in the peripheral and it indicates that the transceiver is ready to perform high level communication with the IP. Intelligent peripherals must wait for the first ip_class_ind primitive before sending any primitive to the transceiver (with the exception of the bic_init_intelligent_cnf, refer to [1]). Any primitives sent to the peripheral before the ip_class_ind primitive contain valid data and can be used by the peripheral.

The initial ip_class_ind primitives may not contain the actual number of abbreviated dialing phonebook locations in the SIM card or EEPROM. The transceiver needs to scan and sort the phonebook locations before it can indicate the number of locations. In addition, the SIM card may be PIN protected. If it is, then the SIM card phonebook is not accessible until a valid PIN is entered. Currently, this interface supports a maximum of 255 locations in EEPROM and SIM combined.

For the restrict phonebook start and restrict phonebook end fields, the phonebook location numbering scheme for the EEPROM and SIM phonebook locations is defined by the numbering scheme field in the ip_abbr_dial_tbl_ind primitive

BROADCAST GROUP: MMI Statistics

IP_CLASS_IND parameters

Name	Format	Valid Values	Description
Reserved	WORD	0	Reserved for future use, peripherals should ignore.
Restrict Phonebook Start	WORD	0-255 0	Start of phonebook location range for the protected (1) and recall only (2) restrict phonebook access modes. Valid for ui1 products only. Obsolete for ui2 products and successors.
Restrict Phonebook End	WORD	0-255 254	End of phonebook location range for the protected (1) and recall only (2) restrict phonebook access modes Valid for ui1 products only. Obsolete for ui2 products and successors.
Number of SIM Locations	BYTE	0-155 255	Number of SIM card abbreviated dialing locations. Number of locations unknown, initialization in progress
Number of E2 Locations	BYTE	0-100 255	Number of EEPROM abbreviated dialing locations. Number of locations unknown, initialization in progress
Language	BYTE	0 1 2 3 4 5 6	Language used for textual information presented to user via the TXVR's man-machine interface. Any values not listed indicate a new language and it is up to the peripheral to decide what language it will use. English German Danish French Italian Spanish Swedish

		7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	Dutch Portuguese Finnish Norwegian Greek Hungarian Turkish Polish Thai Vietnamese Malay Indonesian Tagalog Chinese Czech Complex Chinese
Bad Device	BYTE	0 1-255	Indicates if a bad device condition is present. no_bad_device bad_device
Manual Test	BYTE	0 1	Indicates if TXVR is in manual test mode. in normal mode (not manual test) in manual test mode
Lock State	BYTE	0 1	Indicates if TXVR is locked. unlocked locked
Restrict Phonebook Access Mode	BYTE	0 1 2 3 4 5	Indicates the restrict phonebook access mode. The protected and recall only modes are an alternate, older restriction scheme that only apply to ui1 phones (BMW Phase IV). For these modes, access to the phonebook locations outside of the range defined by the restrict phonebook start and end fields is restricted. no restrictions , all locations can be read/dialed. protected, storing/recalling not allowed outside range (ui1) recall only, only recalling is allowed outside range (ui1) phone only, EEPROM locations can be read/dialed. sim only, SIM locations can be read/dialed. no access, no locations can be read/dialed.
Restrict Keypad Dialing	BYTE	0 1	Indicates if keypad dialing is restricted. If keypad dialing is restricted then all keypad dialing except for emergency dialing is restricted. Note: phonebook locations, which have not been restricted by the restrict phonebook access mode, may be dialed but not programmed. keypad dialing allowed keypad dialing restricted
Restrict Phone Number Length	BYTE	1-20 1-32	Indicates the maximum phone number length allowed for call origination. Only phone numbers less than or equal to this value may be called. Note that emergency dialing is still possible independent of this length. Valid Values for GSM (900Mhz) and DCS (1800Mhz). Valid Values for PCS (1900 Mhz) phones.
Unused 1	BYTE	0	Available for future use
Current Statea	BYTE		>> warm plug capable (bit 0) 0 = not capable of warm plug

			1 = capable of warm plug >> charge only mode (bit 1) 0 = not in charge only mode 1 = in charge only mode >> warm plug active (bit 2) [b] 0 = inactive mode 1 = active mode >> reserved for future use (bits 3-7) 0 = reserved bits are zeroed
Unused	BYTE	0	Available for future use

+CIP: 40,a829,0090000000FE786400000000000014000100FFFF-----**ip_class_ind**

+CIP: 40,a829,0090-0000-00FE-78-64-00-00-00-00-00-00-14-00-01-00FFFF----

254--120-100 -20-

Reserved -0090
RestrictPhonebook Start -0000
RestrictPhonebook End -00FE--254
Number of SIM Locations -78----120
Number ofE2 Locations -64----100
Language -00----English
Bad Device -00
Manual Test -00
Lock State -00----unlocked
RestrictPhonebook AccessMode-00
RestrictKeypadDialing -00
Restrict Phone Number Length-14-----20
Unused 1 -00
Current Statea -01
Unused 21 -00

7.2 Power Down

At power down the transceiver will inform peripherals via the ip_stop_req primitive that the transceiver is powering down. A peripheral that receives an ip_stop_req should perform its own shut down procedure which may include saving some information from the transceiver. After this procedure is completed, the peripheral should inform the transceiver via the ip_stop_cnf primitive that it is ready for the power down.

Since peripherals may go insane, the transceiver will eventually time out waiting for ip_stop_cnf primitives from the peripherals. However, in the error recovery case, significant additional time is added to the power down process which may cause user dissatisfaction. The peripheral must respond with an ip_stop_cnf primitive in normal situations.

BROADCAST GROUP: Power Down

IP_STOP_REQ parameters			
Name	**Format**	**Valid Values**	**Description**
None	None	none	

+CIP: 0,a82f,----------IP_STOP_REQ (transc->periph.)

7.3 Phonebook Related Primitives

The transceiver provides the peripheral with information on phonebook locations via the ip_class_ind, ip_pd_usage_ind and ip_abbr_dial_tbl_ind primitives. Peripherals can implement a phonebook browsing interface using the information available with these primitives and the ip_get_info_element_req and ip_get_info_element_cnf primitives. The primitives support phonebook browsing by location number and sorted alphabetically by alpha-tag. Please note that GSM Recommendation 07.07 defines a standards-based phonebook interface which is available and defined in [4]. This alternate interface is the preferred interface for future applications.

The transceiver sends an ip_pd_usage_ind primitive to inform peripherals that a phonebook location (personal directory location) is being used to originate a call.

BROADCAST GROUP: Personal Directory Statistics

IP_PD_USAGE_IND parameters			
Name	**Format**	**Valid Values**	**Description**
Memory Type	WORD	75 other	Abbreviated Dialing memory location. Reserved and should be ignored by the peripheral.
Device Type	WORD	0 1 other	Memory location resides in EEPROM Memory location resides in the SIM Reserved and should be ignored by the peripheral.
Location	BYTE	1..255	Abbreviated dialing location used per device type.
Reserved	3 BYTES		Padding added by compiler, peripheral should ignore.

--CALLING_FROM_PB_ABRA_DIAL--NO1--EPROM---
ENTER_SMART_BUTTEN

+CIP: 16,**a826**,004B-0000-01-FFFFFF----------**IP_PB_USAGE_IND**

Memory Type 004B----75
Device Type 0000--- EEPROM
Location 01
Reserve FF-FF-FF

+CIP: 16,**a826**,004B-0001-01-FFFFFF----------**IP_PB_USAGE_IND**
75 SIM LOCATION-1

The transceiver sends an ip_abbr_dial_tbl_ind primitive to provide peripherals with information on abbreviated dialing locations in EEPROM and the SIM card.

BROADCAST GROUP: Personal Directory Statistics

IP_ABBR_DIAL_TBL_IND parameters

Name	Format	Valid Values	Description
Reserved	WORD		Reserved for future use, peripherals should ignore.
Numbering Scheme	BYTE	0	The Numbering Scheme indicates how the transceiver interprets abbreviated dialing location numbers, e.g., EEPROM locations followed by SIM locations. This information is necessary so that a peripheral can assign the same meaning to location references and provide MMI consistency. Note that EEPROM locations followed by SIM locations is equivalent to the `MT' storage type defined in [4]. EEPROM locations followed by SIM locations.
Table ID	BYTE	0 1	Usage Table Alpha Sort Table
Reserved	WORD		Reserved for future use, peripherals should ignore.
Usage Table or Alpha Sort Table	32-255 BYTES		The Usage Table is a bitmap that indicates the abbreviated dialing locations that contain a number or alpha-tag. When a bit is set to one the location contains a number or alpha-tag. The first byte contains information on locations 1 thru 8, LSB is location 1. The second byte contains information on locations 9 thru 16, LSB is location 9. And so on. The Alpha Sort Table is a table containing all abbreviated dialing locations that have an alpha-tag defined. Each byte contains a location number. The table is sorted alphabetically. The end of the table is indicated when a byte has a value of zero or the 255th byte has a valid location number. Since the transceiver supports a maximum of 255 locations, this field can contain a maximum of 255 bytes.

+CIP: 32,**a831**,0090-00-01-FFFF-9669676F01666ECB6500
01-alpha_sort_table

Reserved 0090
Numbering Scheme 00
Table ID 01-alpha_sort_table
Reserved FFFF
Usage Table orAlpha Sort Table 96-69-67-6F-01-66-6E-CB-65-00

+CIP: 102,**a831**,0101-00-00-DFF7-
0100000000000000000000000F06100000000200000000000000400000000000000000000000000000000000
00-usage_table

Reserved 0101
Numbering Scheme 00
Table ID 00-Usage_table
Reserved DFF7

Usage Table orAlpha Sort Table
0100000000000000000000000F06100000000200000000000000400000000000000000000000000000000000

7.4 Display Indicator Primitives

The transceiver sends an ip_indr_ctrl_state_ind primitive to inform peripherals of display indicator state changes in the transceiver's display. At power-up all indicators are assumed to be off. No ip_indr_ctrl_state_ind primitives are supplied to indicate this initial state. Following a warm-plug attach, ip_indr_ctrl_state_ind primitives are sent to provide the current state of the indicators.

BROADCAST GROUP: Indicator

IP_INDR_CTRL_STATE_IND parameters

Name	Format	Valid Values	Description
Indicator ID	BYTE	0 1 2	IN USE indicator ROAM indicator NO SERVICE indicator
Indicator State	BYTE	0 1 2	Off On Flashing
Reserved	3 BYTEs		Padding added by compiler, peripheral should ignore.

For the IN USE indicator

Off(0) Phone not in use. No call in progress.

On(1) Phone in use. A call is in progress.

Flashing(2) Not applicable.

For the NO SERVICE indicator

Off(0) The phone is registered with a system.

On(1) The phone is outside any system coverage.

Flashing(2) The phone is in an area with coverage, but is not registered with the system. Only emergency calls (112) are allowed.

The ROAM indicator has meaning only if the NO SERVICE indicator is off.

Off(0) The phone is registered with its home network.

On(1) The phone is registered with a preferred system other than home.

Flashing(2) The phone is registered with a non-preferred system.

+CIP: 8,**a825**,00-01-0000 **--ip_indr_ctrl_state_ind--**in call
oo-in_use
01- calling

Indicator ID -00 in_use

Indicato State -01- calling

Reserved -00-00

Call Control Interface

The call control interface primitives deal with the control of voice calls.

7.5 Background

The transceiver's voice calls are always under parallel call control. This means that any peripheral or handset connected to the transceiver may act on a voice call regardless of which device actually established the call.

When a peripheral wants to originate a call it should use the ip_call_start_req primitive. The peripheral can use this primitive to specify the digits to dial (keypad dialing format) or specify a phonebook location (memory dialing format). Automatic redial from a peripheral is not supported.

The presence of a ringing, mobile-terminated call is announced via the ip_call_status_ind primitive. A peripheral can direct the transceiver to answer the call via the ip_call_accept_req primitive. If the peripheral is interested in the outcome of call establishment then it will need to monitor subsequent ip_call_status_ind primitives.

When a peripheral wants to release a call, it can send an ip_call_release_req primitive. The transceiver will supply subsequent call status information via the ip_call_status_ind primitive.

7.6 Call Restrictions

Call restriction settings in the transceiver's EEPROM and SIM card can affect the call control interface.

Restrict keypad dialing is a flex option. It can prevent keypad dialing except for emergency dialing. Memory dialing from phonebook locations is allowed per additional limitations which may be imposed by restrict phonebook access options. The restrict keypad dialing field in the ip_class_ind primitive indicates when keypad dialing is restricted.

Restrict phonebook access is a flex option. It can prevent various types of phonebook dialing (memory dialing). The restrict phonebook access mode, restrict phonebook start, and restrict phonebook end fields in the ip_class_ind primitive indicate the transceiver's restricted phonebook access settings.

Restrict phone number length is a flex option. It controls the maximum phone number length for mobile originated calls. For example, the maximum phone number length can be set to prevent international dialing. Emergency dialing is always allowed regardless of the maximum phone number length. The restrict phone number length field in the ip_class_ind primitive indicates the transceiver's maximum phone number length.

Newer SIM cards support the fixed dialing feature. A special SIM card phonebook contains a list of phone number prefixes that can be used for outgoing calls. When fixed dialing is enabled, the leading digits in an outgoing call must match a number in the fixed dialing phonebook. The fixed dialing status can be determined via primitives in [4].

Retrict incoming calls is a flex option. This restriction prevents peripherals from being informed of mobile terminated call establishing events via the ip_call_status_ind primitive. This restriction is not communicated to peripheral directly.

7.7 Call Status Indication

The transceiver sends an ip_call_status_ind primitive to announce a change in the status of a voice calls that it controls.

Note that an IP may receive what it considers duplicate call status indications, that is, primitives with the same information more than once. IPs must not be affected by receiving duplicate call status indications.

<Idle> means CC has returned to the fully Idle state. No communication with the network is in progress. Note that CC may go to the Idle state from any other state

<MO Establishment> means CC is attempting to establish a mobile originated call.

<Waiting to Answer MT Call> means the network is attempting to establish a call. CC is waiting for some entity to tell it to answer the call.

<Completing MT Establisment> means an entity has told CC to answer the call. CC is completing the process of establishing the call.

<Fully Active> means call establishment has completed. The current call is now fully active.

<Releasing> means the current call has started releasing. Note that CC may go to the Releasing state from any state except Idle.

The ip_call_status_ind contains a local tone status bit, which indicates the phone is generating tones locally after a call attempt has failed. The local tone status bit is only valid when the current call state is idle. In all other call states the peripheral should ignore the local tone status bit.

BROADCAST GROUP: Call

IP_CALL_STATUS_IND parameters			
Name	**Format**	**Valid Values**	**Description**
Local Tone	BYTE		>> local tones generated by transceiver (bit 7) 0 = local tones off 1 = local tones on >> bits 0-6 are reserved peripheral must ignore these bits
Extended Call States	BYTE		Bits indicate current and previous extended call states related to waiting calls, held calls, and multiparty calls. >> Previous Call State (high nibble) 1000 - Multipary call present 0100 - Held call present 0010 - Active call present 0001 - Incoming / Waiting call present >> Current Call State (low nibble) 1000 - Multiparty call present 0100 - Held call present 0010 - Active call present 0001 - Incoming / Waiting call present
Reserved	BYTE		Reserved for future use, peripherals must ignore.
Current Call State	BYTE	0 1 2 3 4 5 6 7 8	>> upper nibble is reserved peripheral must ignore these bits >> lower nibble Idle MO Establishment Waiting to Answer MT Call Completing MT Establishment Fully Active (includes call on hold) Releasing Redial Call Pending MO Alerting
Previous Call State	BYTE	Same as" Current Call State" (0 - 8)	>> upper nibble is reserved peripheral must ignore these bits >> lower nibble
Reserved	3 BYTE		Padding added by compiler, peripheral should ignore

+CIP: 16,**a827**,0000000700FF42D1----------MO PENDING

+CIP: 16,**a827**,0011000200FFFFFF----------11-INCOMING CALL
02-WAITING TO

+CIP: 16,**a827**,001000030053FFFF----------03-COMPLETING MT ESTA.

+CIP: 16,**a827**,0010000300C0FFFF

+CIP: 16,**a827**,002200040008FFFF----------04-ACTIVE CALL

+CIP: 16,**a827**,002200040008FFFF----------04-ACTIVE CALL

Local Tone -00
Extended3Call States -22---Active/previous_call_present
Reserved -00
CurrentCall State -04----Mo establishment

PreviousCall State -00
Reserved -08-FF-FF

7.8 Generate DTMF Signalling

A peripheral can send ip_call_dtmf_req primitives so that DTMF signalling will be sent to the network. The network generates the tones to the called party. The ip_call_dtmf_req primitive does not generate keypress feedback tones. The ip_key_feedback_ind primitive can be used for this purpose.

Currently, DTMF signaling can only be sent during a call when the current state is Fully Active, see ip_call_status_ind. If the transceiver receives an ip_call_DTMF_REQ when it is not allowed then the request is ignored. If DTMF signaling is not allowed then the transceiver will simply ignore the primitive.

In the future, DTMFsignalling may be allowed in other call states. DTMF signaling will never be allowed in the Idle state. This will prevent nuisance primitives every time the user presses a key on the peripheral.

The peripheral should send two ip_call_dtmf_req primitives for each DTMF digit. The first is normally sent as a result of a user's key press. It should indicate Start DTMF Signaling. The second is normally sent as a result of a user's key release. It should indicate Stop DTMF Signaling. For the second, the timestamp field should indicate the amount of time in milliseconds that the signaling should last. This is usually the amount of time that the user has held down the key. The transceiver uses the timestamp to produce DTMF signaling for the correct amount of time in case of network delays or other problems.

IP_CALL_DTMF_REQ parameters			
Name	**Format**	**Valid Values**	**Description**
Time Stamp	LWORD	0 non-zero	If Start DTMF Signaling, then should be set to zero. Otherwise, should be set to time in milliseconds since start.
Start/Stop	BYTE	0 1	Stop DTMF Signaling Start DTMF Signaling
Character Set	BYTE	0	The character set defines how the DTMF digit is formatted. Motorola GSM Character Set (ASCII)
DTMF Digit	BYTE	`0'-'9','*','#' ASCII	DTMF digit to start/stop per Character Set

at+cip=14,A835,0017,00000000010031-------START--------ip_call_dtmf_req
OK
Time Stamp 00 00 00 00
Start 01
Character Set 00
DTMF Digit 31 (‘1’)

at+cip=14,A835,0017,00000020000031--------END---------ip_call_dtmf_req
OK

7.9 Hook-switch Status Indicator

The transceiver sends an ip_hookswitch_ind primitive to inform peripherals of the status of portable/external handset(s), analog/digital hands free device(s), and the boom headset (hearing aid adaptor) device.

BROADCAST GROUP: Indicator

IP_HOOKSWITCH_IND parameters

Name	Format	Valid Values	Description
Update Reason	BYTE	0 1 2 3 4 5 6 7 8 9 10 11 12	Flip State Change Boom Headset Add/Remove Analog Hands-free Add/Remove Digital Hands-free Add/Remove Analog Handset Add/Remove Digital Handset Add/Remove Portable Cradle State Change External Digital Handset Lifted External Digital Handset Hung-Up Handset/Hands-free Toggle Call State Begin/End Exit Manual Test Invalid Reason
Reserved	BYTE		Reserved for future use, peripheral must ignore.
Info Mask	BYTE		>> flip state (bit 0) 0 = closed 1 = open, or no flip >> boom headset device (bit 1) 0 = not present 1 = present >> bits 2-7 are reserved for future use peripheral must ignore
Hands-free Present Mask	BYTE		>> analog hands-free speakers (bit 0) 0 = not present 1 = present >> hands-free digital devices (bits 1-7) 0 = not present 1 = present >> if Hands-free Present Mask byte is 0 then there are no hands-free devices.
Handset Present Mask	BYTE		>> portable handset (bit 0) 0 = not present (mobile/transportable) 1 = present (portable phone) >> external digital handset (bits 1-7) 0 = not present 1 = present >> if Handset Present Mask byte is 0 then there are no handsets
Handset Active Mask	BYTE		>> portable cradle state (bit 0) 0 = in cradle, or not a portable 1 = not in cradle, or not supported >> external digital handset (bits 1-7) 0 = on hook (in cup)

			1 = off hook (out of cup) >> if Handset Active Mask byte is 0 then all handsets are on hook
Reserved	WORD		Padding added by compiler, peripheral should ignore.

----------**PICK_UP_HS**

+CIP: 16,**a809**,07-00-00-05-04-0E-FFFF----------**IP_HOOKSWITCH_IND**

07-handset_lifted

Update Reason----------07-- External Digital Handset Lifted

Reserved----------00

Info Mask----------00

Hands-free Present Mask-----05-- analog hands free speakers present & hands free digital devices present (dsc add no 2)

HandsetPresent Mask--------04-->> external digital handset present

HandsetActive Mask4---------0E

Reserved----------FFFF

----------**HS_HUNG_UP**

+CIP: 16,**a809**,08-00-00-05-00-00-FFFF----------**IP_HOOKSWITCH_IND**

7.10 Microphone Mute Primitives

A peripheral can send an ip_mute_req primitive to instruct the Audio Manager to update the microphone mute state. There is no confirmation to this primitive but there is an ip_mute_ind primitive.

IP_MUTE_REQ parameters			
Name	**Format**	**Valid Values**	**Description**
Type	BYTE	0	Toggle microphone mute state, off->on or on->off

The transceiver sends an ip_mute_ind primitive to indicate a change in the microphone mute state. The microphone mute state can be changed by an intelligent peripheral via the ip_mute_req primitive. It can also be changed via the phone's man-machine interface.

BROADCAST GROUP: Indicator

IP_MUTE_IND parameters			
Name	**Format**	**Valid Values**	**Description**
Mute State	BYTE	0 1	Microphone muting is OFF Microphone muting is ON
Reserved	3 BYTEs		Padding added by compiler, peripheral should ignore.

+CIP: 8,a808,01460000----------ip_mute_ind--01-mute_on

+CIP: 8,a808,00060401----------ip_mute_ind--00-mute_off

Mute state 00
Padd 06 04 01

7.11 SEEM Interface

At power up, after the transceiver has determined the card readers present on the DSC bus, it will choose a card reader and SIM card to activate. The transceiver gives a SIM card in an external card reader priority over a SIM card in the internal card reader. For the details on individual card reader procedures at power up, power down, SIM card deactivation, and SIM card insertion refer to .

The primitives listed in the following sections can be used to determine SIM card status. In general there are two service categories: limited service and ready for full service. With limited service, no SIM data fields can be accessed and only emergency calls can be placed. The following table documents how to determine the service status category but does not document all possible return status values for each of the primitives involved. Only primitives with a documented return status should be used to determine the SIM card status. Primitive/return status pairs not shown should be ignored.

SIM Card Status			
SIM Card Status	**Primitive**	**Return Status**	**Description**
Insert Card **(Emergency Only)**	SEEM_ACTIVATE_CNF SEEM_DEACTIVATE_IND	No SIM No SIM	No card in any card reader at power up. The active card was removed.
Check Card **(Emergency Only)**	SEEM_DEACTIVATE_IND SEEM_ACTIVATE_IND SEEM_ACTIVATE_CNF	Bad SIM Bad SIM	Bad card, error in communications, or card is backwards. Bad card detected at power up or when activating a new card.
Enter PIN **(Emergency Only)**	SEEM_STATUS_CNF SEEM_PIN_VERIFY_CNF	PIN Enabled Bad Code	A PIN enabled card has been inserted. Incorrect PIN entered. `Wrong PIN' will blink.
Blocked **(Emergency Only)**	SEEM_STATUS_CNF SEEM_PIN_CHANGE_CNF SEEM_PIN_DISABLE_CNF	PIN Blocked PIN Blocked	A PIN blocked card has been inserted. Incorrect PIN entered more than 3

	SEEM_PIN_ENABLE_CNF SEEM_PIN_VERIFY_CNF SEEM_UNBLOCKING_CNF	 PIN Blocked	times, card is blocked An incorrect unblock code was entered
Bad Card see Supplier **(Emergency Only)**	SEEM_STATUS_CNF SEEM_PIN_CHANGE_CNF SEEM_PIN_DISABLE_CNF SEEM_PIN_ENABLE_CNF SEEM_PIN_VERIFY_CNF SEEM_UNBLOCKING_CNF	No Secret Code or Other Technical Problem	The SIM card is defective.
Blocked see Supplier **(Emergency Only)**	SEEM_STATUS_CNF SEEM_UNBLOCKING_CNF	Permanent Blocked	The SIM card is permanently blocked.
Transition to New Status in Process **(Emergency Only)**	SEEM_ACTIVATE_CNF	SIM Available	SIM card is activated
Ready for Full Services	SEEM_STATUS_CNF SEEM_PIN_VERIFY_CNF SEEM_UNBLOCKING_CNF	PIN Disabled Success Success	PIN code is disabled PIN entry has unlocked the SIM card PUK entry has unblocked the SIM card

7.12 Idle SIM Card Notification

The transceiver sends a seem_activate_ind primitive to indicate that an idle, non-active SIM card has been inserted or removed. This primitive does not indicate anything about the status of the active SIM card.

BROADCAST GROUP: SIM Availability

SEEM_ACTIVATE_IND parameters			
Name	**Format**	**Valid Values**	**Description**
SIM Status	WORD	1 2 4	No SIM, idle SIM removed or no alternate SIM present. Bad SIM Idle SIM, idle SIM inserted.
Reserved	WORD		Padding added by compiler, peripheral should ignore.

+CIP: 8,**1403**,0004-007F--------04_idle_sim--------**SEEM_ACTIVATE_IND**

SIM Status- --0004→ Idle SIM, idle SIM inserted.
Reserved------007F

+CIP: 8,**1403**,0001-0381---01_no_sim_==remove_sim--**SEEM_ACTIVATE_IND**

SIM Status- --0001→ No SIM, idle SIM removed or no alternate SIM present
Reserved------007F

7.13 SIM Card Deactivation Notification

The transceiver sends a seem_deactivate_ind primitive to indicate that the active SIM card has been removed or is no longer usable because of a SIM card communication failure. This primitive always indicates that the active SIM card is no longer usable.

BROADCAST GROUP: SIM Availability

SEEM_DEACTIVATE_IND parameters			
Name	**Format**	**Valid Values**	**Description**
SIM Status	WORD	1 2	No SIM, active SIM card has been removed Bad SIM, phone can no longer talk to the active SIM card.
Reserved	WORD		Padding added by compiler, peripheral should ignore.

+CIP: 8,**1406**,0001-0381----------01-no_sim---**SEEM_DEACTIVATE_IND**

SIM Status- --0001→. No SIM, active SIM card has been removed
Reserved------0381

7.14 SIM Card Activation Notification

The transceiver is responsible for deciding when to initiate a SIM card activation. It will forward a copy of the seem_activate_cnf primitive to subscribing peripherals. Therefore, a peripheral can use the seem_activate_cnf to determine the state of the active SIM card.

BROADCAST GROUP: SIM Availability

SEEM_ACTIVATE_CNF parameters			
Name	**Format**	**Valid Values**	**Description**
SIM Status	WORD	0 1 2	SIM Available, active SIM has answered to reset properly No SIM, there is no active SIM card Bad SIM, phone cannot talk to the active SIM card
Reserved	WORD		Padding added by compiler, peripheral should ignore.

+CIP: 8,1402,0001-0200--------01_no_sim----------**SEEM_ACTIVATE_CNF**

SIM Status- --0001→. No SIM, active SIM card has been removed
Reserved------0200

7.15 SIM Card Security Notifications

Shortly after the transceiver activates a SIM card it will check the PIN status of the SIM card. When provided, the transceiver will subsequently coordinate the submission of the PIN, PUK, etc. codes to the SIM card. The transceiver

forwards a copy of the confirmation primitives associated with these procedures to peripherals. This allows peripherals to track the security status of the active SIM card. Peripherals may also check the active SIM card's security status via the newer MMI primitives ip_gen_pin_status_req and ip_gen_pin_status_cnf.

Right after SIM card activation, the transceiver forwards a seem_status_cnf primitive to peripherals

BROADCAST GROUP: SIM Security/Access

SEEM_STATUS_CNF parameters			
Name	**Format**	**Valid Values**	**Description**
PIN Result	WORD	2 3 5 6 7 8	PIN Enabled, PIN entry required PIN Disabled, no PIN entry required. PIN Blocked, user must enter PUK to unblock Permanent Blocked No Secret Code Other Technical Problem
Reserved	WORD		Padding added by compiler, peripheral should ignore.

+CIP: 8,140f,0003-0300-----03_pin_disable----------**SEEM_STATUS_CNF**

PIN Result - --0003→. PIN Disabled, no PIN entry required
Reserved------0300

Following a PIN entry attempt, the transceiver forwards a seem_pin_verify_cnf primitive to peripherals.

BROADCAST GROUP: SIM Security/Access

SEEM_PIN_VERIFY_CNF parameters			
Name	**Format**	**Valid Values**	**Description**
PIN Result	WORD	0 1 5 7 8	Success, PIN verification successful Bad Code, PIN verification failure, not PIN blocked PIN Blocked, from 3rd PIN verification failure No Secret Code Other Technical Problem
Reserved	WORD		Padding added by compiler, peripheral should ignore.

+CIP: 8,**1417**,0005-0300-----05_PIN_BLOCKED----**SEEM_PIN_VERIFY_CNF**

PIN Result - --0005→. PIN Blocked, from 3rd PIN verification failure
Reserved------0300

Following a PUK entry attempt, the transceiver forwards a seem_unblocking_cnf primitive to peripherals.

BROADCAST GROUP: SIM Security/Access

SEEM_UNBLOCKING_CNF parameters			
Name	**Format**	**Valid Values**	**Description**
PIN Result	WORD	0 1 6 7 8	Success, PUK verification successful Bad Code, PUK verification failure, not permanent blocked Permanent Blocked, from 3rd PUK verification failure No Secret Code Other Technical Problem
Reserved	WORD		Padding added by compiler, peripheral should ignore

+CIP: 8,**1419**,0000-0300-----00_SUCCESS_PUK(PUK2)--**SEEM_UNBLOCKED_CNF**

PIN Result - --0000→. Success, PUK verification successful
Reserved------0300

Following a PIN disable attempt, the transceiver forwards a seem_pin_disable_cnf primitive to peripherals.

BROADCAST GROUP: SIM Security/Access

SEEM_PIN_DISABLE_CNF parameters			
Name	**Format**	**Valid Values**	**Description**
PIN Result	WORD	0 1 3 5 7 8	Success, no PIN entry required at power-up. Bad Code, PIN does not match, PIN not disabled PIN Disabled, PIN entry was already disabled PIN Blocked, from 3rd bad PIN code No Secret Code Other Technical Problem
Reserved	WORD		Padding added by compiler, peripheral should ignore.

+CIP: 8,**1413**,0000-0300-----_SUCCESS_DISABLE--**SEEM_PIN_DISABLE_CNF**

PIN Result - --0000→. Success, PUK verification successful
Reserved------0300

Following a PIN enable attempt, the transceiver forwards a seem_pin_enable_cnf primitive to peripherals.

BROADCAST GROUP: SIM Security/Access

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SEEM_PIN_ENABLE_CNF parameters			
Name	**Format**	**Valid Values**	**Description**
PIN Result	WORD	0 1 2 5	Success, PIN entry required at power-up. Bad Code, PIN does not match, PIN not enabled PIN Enabled, PIN entry was already enabled PIN Blocked, from 3rd bad PIN code

		7 8	No Secret Code Other Technical Problem
Reserved	WORD		Padding added by compiler, peripheral should ignore.

+CIP: 8,**1415**,0000-0300----00_SUCCESS_ENABLE--**SEEM_PIN_ENABLE_CNF**

PIN Result - --0000→. Success, PIN entry required at power-up.
Reserved------0300

Following a PIN change attempt, the transceiver forwards a seem_pin_change_cnf primitive to peripherals.

BROADCAST GROUP: SIM Security/Access

SEEM_PIN_CHANGE_CNF parameters			
Name	**Format**	**Valid Values**	**Description**
PIN Result	WORD	0 1 4 5 7 8	Success, PIN code was changed Bad Code, old PIN does not match, not changed Not Allowed, PIN entry is not enabled cannot change PIN Blocked, from 3rd bad PIN code No Secret Code Other Technical Problem
Reserved	WORD		Padding added by compiler, peripheral should ignore

+CIP: 8,**1411**,0000-0300->00_SUCCESS_PIN_CHANGE---**SEEM_PIN_CHANGE_CNF**

PIN Result - --0000→. Success. , PIN code was changed
Reserved------0300

Following a warm plug attach, the transceiver sends a seem_card_status_ind primitive with current SIM card security information. Peripherals should be careful using the PIN result field. This field contains the status of the last security operation. It's meaning is largely dependent on the last security operation attempted. The ip_gen_pin_stat_req and ip_gen_pin_stat_cnf primitives are a more reliable mechanism for determining the PIN status of the active SIM card following a warm plug attach.

BROADCAST GROUP: SIM Security/Access

SEEM_CARD_STATUS_IND parameters			
Name	**Format**	**Valid Values**	**Description**
PIN Result	WORD	0 1 2 3 4 5 6 7 8	Success, last operation successful Bad Code, last operation not successful PIN Enabled, PIN entry was already enabled PIN Disabled, PIN entry was already disabled Not Allowed, last operation is not allowed PIN Blocked, from 3rd bad PIN code Permanent Blocked, from 3rd pad PUK code No Secret Code Other Technical Problem

		9	Switch Band
SIM Status	WORD	0 1 2 3 4 5 6 7 8 9	SIM Available, active SIM has answered to reset properly No SIM, there is no active SIM card Bad SIM, phone cannot talk to the active SIM card Good SIM, after test card Idle SIM, new card just inserted Uninitialized SIM, no secret code and perm blocked Active SIM, current working card in for table Clone SIM, clone card indication to MMI Good Clone, after test clone card Active Clone, current working clone card for table

+CIP: 8,**142b**,0004-0004----------**SEEM_CARD_STATUS_IND**

PIN Result - --0004→. Success. last operation successful
SIM Status ---0004-> Not Allowed, last operation is not allowed

7.16 Attached peripherals

The IP_ATTACHED_PERIPHERALS_IND primitive purpose is to inform the IP about the mobile's peripherals status.

It will inform all DSC addresses hold by peripherals, their types and specific information , as well as unregistered or failed peripherals.

The IP_ATTACHED_PERIPHERALS_IND primitive consists of the following fields:

DSC_ADDR - This is the DSC address that the radio has allocated to the
peripheral.

PRODUCT_ID - This says what kind of peripheral is present
(i.e. card reader, DHFA, eject box, etc.)

BIC_SERIAL_NUM - Serial number of peripheral device, programmed into BIC EEPROM.

SW_VERSION_NUM - Peripherals software version number.

STATUS - The status of the peripherals. Either ALIVE or DEAD.
On "dead" status, the peripherals either does not exist on the
dsc bus or it does exist but has failed to initialize.

FAILED_TO_INITIALIZE - This is "true" if the peripherals is actually attached to the
dsc bus but has failed during the initialization process.
If this field is "false" then there is no peripherals attached
to the DSC bus.

DEVICE_TYPE_BMAP - This bit-mapped field holds all the Call Processor events which
this peripheral is interested in receiving.

Those seven fields are held for each peripheral attached to the radio.
In addition, there are two fields that hold the number of ALIVE peripherals on the bus and the number of peripherals, which have failed during the initialization process.

NUM_OF_ALIVE - Number of ALIVE peripherals.

NUM_OF_FAILED - Number of peripherals that have failed to initialize.

BROADCAST GROUP

IP_NUM_OF_ATTACHED_PERIPHERALS_IND pars			
Name	**Format**	**Valid Values**	**Description**
NUM_OF_ALIVE		0-7	Total number of alive (registered)peripheral
NUM_OF_FAILED		0-7	Total number of failed (unregistered)peri

+CIP: 4,**a890**,02-00

NUM_OF_ALIVE--02→ Total number of alive (registered)peripheral
NUM_OF_FAILED—00-> Total number of failed (unregistered)peri

IP_ATTACHED_PERIPHERALS_INFO_IND parameters			
	Name	**Valid Values**	**Description**
DSC_ADDR	BYTE	1-7	
PRODUCT_ID	WORD	0000-0fff Dumb / HS 8000-8010 Emmi 8011 E. SIM C/R 8034 ACP TCU Jaguar 8031 TeleAid DC 8032 TeleAid DC	Show the product type (TCU,EMMI,SIM etc)
BIC_SERIAL NUM	6 BYTES		If exist and status is dead, it means this peripheral failed to register
SW_VERSION	WORD		
STATUS	BYTE	0,2	0 - live (registered) peripheral 2 - dead (no peripheral or failed to register)
FAILED_TO INITIALIZE	WORD		

DEVICE_TYPE BMAP	LWORD	0001 Emmi ..... 0010 Data ..... 0020 SIM ..... 0040 BMW TCU 0080 Gen. TCU ..	

HS LIVE
+CIP: 36,a88f,02-000A-000A017402A8-0000-00-0000-00000000

DSC_ADDR----------02
PRODUCT_ID----------000A----------→0000-0fff Dumb / HS
BIC_SERIAL NUM---------00-0A-01-74-02-A8
SW_VERSION----------0000
STATUS----------00----------→0 - live (registered) peripheral
FAILED_TO INITIALIZE—0000
DEVICE_TYPE BMAP------00-00-00-00

+CIP: 36,a88f,01-8011-8011017402A0-3309-00-0000-00000020

LIVE SIM

7.17 IP_HF_AUDIO_STATUS_IND

Indication whenever any type of audio is starting or ending.
The purpose of this primitive is to let the TCU know about pending audio , in order to synchronize other audio related machines like entertainment radio etc.

Name	Format	Valid Values	Description
Audio_status	BYTE	1 0	Audio Started Audio Ended
Reserved	3 BYTE		Padding added by compiler, peripheral should ignore

+CIP: 8,**a888**,01-9F17DE----------**IP_HF_AUDIO_STATUS_IND**
Audio_status-----01
Reserved---------9F-17-DE

+CIP: 8,**a888**,00-9F17DE----------**IP_HF_AUDIO_STATUS_IND**

Audio_status-----00

Reserved---------9F-17-DE

7.18 IP_SET_RING_LEVEL_REQ

Allow TCU to control the ringer gain level.

Name	Format	Valid Values	Description
Ring_type	BYTE	N/A	unused
Ring_level	BYTE	0-7	Ring gain
Addressing_info	BYTE	N/A	unused

at+cip=6,**a88b**,0017,00-05-00----------**ip_set_ring_level_req**

Ring_type----------00

Ring_level----------05---- Req ring gain

Addressing_info------00

7.19 IP_SET_RING_LEVEL_CNF

A confirmation regards the ringer gain level request.

The answer will contain the gain level adjusted and the status results.

The status results will indicate weather the gain requested was out of limits or valid results.

Name	Format	Valid Values	Description
Ring_type	BYTE	N/A	unused
Ring_level	BYTE	0-7	Ring gain
Addressing_info	BYTE	N/A	unused
Req_status	BYTE	0 1 2 3	less_than_min, same_level, more_than_max, level_is_changed

+CIP: 8,a88c,00-05-00-03----------**ip_set_ring_level_cnf**

Ring_type----------00--
Ring_level----------05-- Ring gain
Addressing_info-------00--
Req_status----------03-- level_is_changed

7.20 IP_LOW_VOLTAGE_IND

Indicate any pass from one voltage level to another.

Due to HW defense circuitry , it might be that the XCVR will not arrive to the points: under voltage & over voltage.

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Name	Format	Valid Values	Description
Low_voltage_state	BYTE	1 2	Low voltage -- Battery with "low batt active" Normal volt--.FULL battery - out of low batt

7.21 IP_GET_HF_VOLUME_REQ

Request for HF voice and ringer gain levels.

Name	Format	Valid Values	Description
Addressing_info	BYTE	N/A	Unused

at+cip=2,A886,0017,00----------**ip_get_hf_volume_req**
addressing_info----00

7.22 IP_GET_HF_VOLUME_CNF

Return the HF voice and ringer gain levels.

Name	Format	Valid Values	Description
Voice_gain_level	BYTE	0-7	Voice - HF gain level
Ring_gain_level	BYTE	0-7	Ringer - HF gain level
Success	BYTE	1	PASS
Addressing_info	BYTE	N/A	Unused

+CIP: 8,a887,07--04--01-00----------**ip_get_hf_volume_cnf**
VOICE RING

Voice_gain_level------07--- Voice - HF gain level
Ring_gain_level-------04---- Ringer - HF gain level
Success----------01
Addressing_info-------00

7.23 IP_LTC_ERASED_IND

Indicate the TCU that there are no phone number in the LTC (last ten call) list , or in other words the last dialed number erased.

Name	Format	Valid Values	Description
Erased	BYTE	0 1	Not erased Erased
Reserved	3 BYTEs		Padding added by compiler, peripheral should ignore.

+CIP: 8,**a88a**,01-00004D----------**ip_ltc_erased_ind**
01-ltc_erased

Erased 01------ltc_erased
Reserved 00-00-4D

8. IP primitives CIP examples

IP_CALL_STATUS_IND Ref. GSM-IP 7.3		
Power up MS . wait response: +CIP: 12,a827,000000000000	Verify the correct response .	The transceiver sends an ip_call_status_ind primitive to announce a change in the status of a voice calls that it controls. Note that an IP may receive what it considers duplicate call status indications, that is, **primitives with the same information** **more**
MO voice call. Dial number. wait response: +CIP: 12,a827,000000**01**0000	Verify the correct response .	**01**- MO established.
MO voice call. Call is alerted. wait response: +CIP: 12,a827,000000**02**0003	Verify the correct response .	**02** - Waiting to answer MO call.

MO voice call. Call is answered. wait response: +CIP: 12,a827,00**22**00**04**0043	Verify the correct response .	**04** - Fully active. **22** - Active call present.
MO voice call. Releasing. wait response: +CIP: 12,a827,00**20**00**05**0006	Verify the correct response .	**05** - Releasing. **20** - Active call state - previous call state.

INDR_CTRL_STATE_IND Ref. GSM-IP 6.14		
Power up MS . No any +CIP:4,A825,XXXX should be send.	Verify the correct response.	The transceiver sends an ip_indr_ctrl_state_ind primitive to inform peripherals of display indicator state changes in the transceiver's display. At power-up all indicators are assumed to be off. No ip_indr_ctrl_state_ind primitives are supplied to indicat
Power up MS . Remove antenna wait response: +CIP:4,A825,**0201** Insert antenna wait response +CIP:4,A825,**0200**	Verify the correct response.	
Power up MS . Make call wait response +CIP:4,A825,**0001** Release call wait response +CIP:4,A825,**0000**	Verify the correct response.	

IP_STOP_REQ Ref. GSM-IP 6.6.		
Power down MS. wait response: +CIP: 0,A82F	Verify the correct response.	At power down the transceiver will inform peripherals via the ip_stop_req primitive that the transceiver is powering down. A peripheral that receives an ip_stop_req should perform its own shut down procedure which may include saving some information from t

ATTACHED_PERIPHERALS_IND Ref. GSM-IP 10.2.		
Power UP MS Wait response: +CIP,XX, A88f,M1...Mn	Verify the correct response.	CIP with ID=A88F replaces CIP with ID=A885. This is TCG solution. +CIP report should be produced for every attached peripheral.

HF_AUDIO_STATUS_IND Ref. GSM-IP 10.4.		
In HF mode press/release any buttons. wait response: +CIP:2,A888,**01** +CIP:2,A888,**00**	Verify the correct response : 2 "+CIP " indicators for every button. **01** - Audio started **02** - audio ended. Verify Side Tone in SPKR.	Indication whenever any type of HandsFree audio is starting or ending. The purpose of this primitive is to let the TCU know about pending HF audio , in order to synchronize other audio related machines like entertainment radio etc.

LTC_ERASED_IND Ref. GSM-IP10.11.		
Make MO call, empty LTC memory area via HS. wait response: +CIP:2,A88A,**01**	Verify the correct response **00** - Not erased **01** - Erased	Indicate the TCU that there are no phone number in the LTC (last ten call) list , or in other words the last dialled number erased.

SEEM_CARD_STATUS_IND Ref. GSM-IP 10.3.

Power-Up MS, wait response: +CIP:8,142B,(**0-9)(0-9)**	Verify the correct response 0 SUCCESS 1 BAD_CODE 2 PIN_ENABLED 3 PIN_DISABLED 4 NOT_ALLOWED 5 BLOCKED 6 PERM_BLOCKED 7 NO_SECRET_CODE 8 OTHER_TECHNICAL_PROBLEM 9 SWITCH_BAND ========== 0 S	This primitive is sent to the IP whenever it received an update from the SIM manager in the mobile..

SEEM_ACTIVATE_IND Ref. GSM-IP 9.1.

Power-Up MS with normal SIM, wait response: +CIP:4,1403,0004	Verify the correct response	This primitive is sent to the IP whenever it received an update from the SIM manager in the mobile..
Power-Up MS without SIM, wait response: +CIP:4,1403,0001	Verify the correct response	
Power-Up MS with BAD SIM, wait response: +CIP:4,1403,0002	Verify the correct response	

SEEM_ACTIVATE_CNF Ref. GSM-IP 9.3.

Power-Up MS with normal SIM, wait response: +CIP:4,1402,000**0**	Verify the correct response	**0** - SIM Available, active SIM has answered to reset properly
Power-Up MS without SIM, wait response: +CIP:4,1402,000**1**	Verify the correct response	**1** - No SIM, there is no active SIM card
Power-Up MS with BAD SIM, wait response: +CIP:4,1402,000**2**	Verify the correct response	**2** - Bad SIM, phone cannot talk to the active SIM

SEEM_DEACTIVATE_IND Ref. GSM-IP 9.2.

Power-Up MS with normal SIM, remove SIM. wait response: +CIP:4,1406,000**1**	Verify the correct response **1** - No SIM, active SIM card has been removed	The transceiver sends a seem_deactivate_ind primitive to indicate that the active SIM card has been removed or is no longer usable because of a SIM card communication failure. This primitive always indicates that the active SIM card is no longer usable**.**
Power-Up MS with BAD SIM, wait response: +CIP:4,1406,000**2**	Verify the correct response **2** - Bad SIM, phone can no longer talk to the active SIM card.	????

SEEM_PIN_CHANGE_CNF Ref. GSM-IP 9.4.

Change PIN via HS menu. Use correct PIN1 code. wait response: +CIP:8,1411,000**0**yyyy	Verify the correct response **0 -** Success, PIN code was changed	Following a PIN change attempt, the transceiver forwards a seem_pin_change_cnf primitive to peripherals.
Change PIN via HS menu. Use wrong PIN1 code. wait response: +CIP:8,1411,000**1**yyyy	Verify the correct response **1 -** Bad Code, old PIN does not match, not changed.	
Change PIN via HS menu. Use wrong PIN1 code three times. wait response: +CIP:8,1411,000**5**yyyy	Verify the correct response **5 -** PIN Blocked, from 3rd bad PIN code	

SEEM_PIN_DISABLE_CNF Ref. GSM-IP 9.4.

Power-Up MS with PIN requested. Set "PIN disabled" via HS menu. Use correct PIN1 code. wait response: +CIP:8,1413,000**0**yyyy	Verify the correct response **0** - Success, no PIN entry required at power-up.	Following a PIN disable attempt, the transceiver forwards a seem_pin_disable_cnf primitive to peripherals.
Power-Up MS with PIN requested. Set "PIN disabled" via HS menu. Use wrong PIN1 code. wait response: +CIP:8,1413,000**1**yyyy	Verify the correct response **1** - Bad Code, PIN does not match, PIN not disabled	
Power-Up MS with PIN requested. Set "PIN disabled" via HS menu. Use correct PIN1. Set "PIN disabled" via HS menu again . wait no response.	Verify the correct response **3** - PIN disabled, PIN entry was already disabled	
Power-Up MS with PIN requested. Set "PIN disabled" via HS menu. Use wrong PIN1 code three times. wait response: +CIP:8,1413,000**5**yyyy	Verify the correct response **5** - PIN Blocked, from 3rd bad PIN code	

SEEM_PIN_ENABLE_CNF Ref. GSM-IP 9.4.		
Power-Up MS . Set "PIN enabled" via HS menu.Use correct PIN1 code. wait response: +CIP:8,1415,000**0**yyyy	Verify the correct response **0** Success, PIN entry required at power-up.	Following a PIN enable attempt, the transceiver forwards a seem_pin_enable_cnf primitive to peripherals.
Power-Up MS . Set "PIN enabled" via HS menu.Use wrong PIN1 code. wait response: +CIP:8,1415,000**1**yyyy	Verify the correct response **1** Bad Code, PIN does not match, PIN not enabled	
Power-Up MS . Set "PIN enabled" via HS menu.Use correct PIN1 code. Try to set "PIN enabled" second time. wait no response:	Verify the correct response **2** PIN Enabled, PIN entry was already enabled	

Power-Up MS . Set "PIN enabled" via HS menu. Use wrong PIN1 code three times. wait response: +CIP:8,1415,000**5**yyyy	Verify the correct response **5** PIN Blocked, from 3rd bad PIN code	

SEEM_PIN_VERIFY_CNF Ref. GSM-IP 9.4.		
Power-Up MS with PIN1 required. Enter correct PIN1. wait response: +CIP:8,1417,000**0**yyyy	Verify the correct response **0** Success, PIN verification successful	Shortly after the transceiver activates a SIM card it will check the PIN status of the SIM card. When provided, the transceiver will subsequently coordinate the submission of the PIN, PUK, etc. codes to the SIM card.
Power-Up MS with PIN required. Enter wrong PIN. wait response: +CIP:8,1417,000**1**yyyy	Verify the correct response **1** Bad Code, PIN verification failure, not PIN blocked	
Power-Up MS with PIN required. Enter wrong PIN 3 times. wait response: +CIP:8,1417,000**2**yyyy	Verify the correct response **5** PIN Blocked, from 3rd PIN verification failure	

SEEM_STATUS_CNF Ref. GSM-IP 9.4.		
Power-Up MS without PIN required. wait response: +CIP:8,140F,000**3**yyyy	Verify the correct response **3** -PIN Disabled, no PIN entry required.	Shortly after the transceiver activates a SIM card it will check the PIN status of the SIM card. When provided, the transceiver will subsequently coordinate the submission of the PIN, PUK, etc. codes to the SIM card.
Power-Up MS with PIN required wait response: +CIP:8,140F,000**2**yyyy	Verify the correct response **2** -PIN Enabled, PIN entry required	

+CIP:8,140F,0002yyyy		
Power-Up MS with PUK1 required wait response: +CIP:8,140F,0005yyyy	Verify the correct response **5** -PIN Blocked, user must enter PUK to unblock	

SEEM_UNBLOCKING_CNF Ref. GSM-IP 9.4.		
Power-Up MS with PUK1 required. Enter wrong PUK1. wait response: +CIP:8,1419,0001yyyy	Verify the correct response **1** Bad Code, PUK verification failure, not permanent blocked	Shortly after the transceiver activates a SIM card it will check the PIN status of the SIM card. When provided, the transceiver will subsequently coordinate the submission of the PIN, PUK, etc. codes to the SIM card.
Power-Up MS with PUK1 required. Enter correct PUK1. wait response: +CIP:8,1419,0000yyyy	Verify the correct response **0** Success, PUK verification successful	

IP MUTE Ref. GSM-PCN.8.3.		
MS is in conversation. AT+CIP=2,A822,0017,00 wait response: +CIP:4,A808,0100	Verify the correct response . Check Mic muting before(off) and after (on) AT command.	**01** means "Microphone muting is "on"
MS is in conversation. AT+CIP=2,A822,0017,00 wait response: +CIP:4,A808,0000	Verify the correct response . Check Mic muting before(on) and after (off) AT command.	**00** means "Microphone muting is "off"

IP CALL DTMF Ref. GSM-PCN.7.7		
Dial *054. Enter AT+CIP=14,A835,0017,00000000010031;+CIP=14,A835,0017, 000001f4000031 no any response.	Verify no response . Check the stepping into menu. Check "1" displayed on HS screen.	**1** : Digit 1 will be send as DTMF signal.
Dial *054. Enter AT+CIP=14,A835,0017,00000000010023;+CIP=14,A835,0017, 000001f4000023 no any response.	Verify no response . Check the stepping into menu. Check "*" displayed on HS screen.	***** : Char. "#" will be send as DTMF signal.
Dial *054. Enter AT+CIP=14,A835,0017,0000000001002B;+CIP=14,A835,0017, 000001f400002B no any response.	Verify no response . Check no stepping into menu. Check no "+" displayed on HS screen.	"**B**" is wrong value. Nothing will be send as DTMF signal.

IP ERROR Ref. GSM 07.07.7.10.		
Enter: AT+CIP=10,A87E,0020,0003000**00** wait response: +CIP:16,A87F,0003FFFF0000ZZZZ		**00**: Read error codes stored in EEPROM. **FFFF** - Indicates success. **ZZZZ** - Code of the stored Error.
Enter: AT+CIP=10,A87E,0003000**01** wait response: +CIP:8,A87F,0003FFFF00000000		**01**: Clear error codes stored in EEPROM. **FFFF** - Indicates success. **0000** - No Error.

IP GET HF VOLUME Ref. GSM-IP 10.8.		
(The phone is in HF mode) Enter: AT+CIP=2,A886,17,FF wait response: +CIP:8,A887,**070401**FF	Check the correct answer.	**XX**: Voice - HF gain level **YY** : Ringer - HF gain level **01** - :PASS(phone is in HF).
(The phone is in HF mode) Enter: AT+CIP=6,A88B,0017,FF05FF Enter: AT+CIP=2,A886,FF wait response: +CIP:8,A887,XXYY**05**FF	Check the correct answer.	**XX**: Voice - HF gain level **YY** : Ringer - HF gain level **00** - FAIL (if the phone is

		not in handsfree).
(The phone is not in HF mode) Enter: AT+CIP=2,A886,FF wait response: +CIP:8,A887,XXYY**00**FF	Check the correct answer.	**XX**: Voice - HF gain level **YY** : Ringer - HF gain level **00** - FAIL (if the phone is not in handsfree).

IP_LTC_ERASED_IND	**A88A**